NOTICE

All drawings located at the end of the document.

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Phase II RFI/RI Work Plan
Operable Unit No. 4
Solar Evaporation Ponds

Appendices

U.S. Department of Energy
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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

APPENDIX A

APPENDIX A

EVALUATION OF THE INTERCEPTOR TRENCH SYSTEM EFFECTIVENESS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EVALUATION OF THE INTERCEPTOR TRENCH SYSTEM EFFECTIVENESS

A.1 INTRODUCTION

The Interceptor Trench System (ITS) was developed as one of many methods to diminish discharges to the environment from the Rocky Flats Plant (RFP). The ITS was built specifically to manage surface water and ground water contaminated by the Solar Evaporation Ponds (SEPs). The ITS, located immediately north and downgradient of the SEPs and SEP hillside seepage, is intended to intercept contaminated surface water runoff and ground water flowing northeast to North Walnut Creek.

An evaluation of ITS effectiveness is necessary to accurately characterize the Operable Unit 4 (OU4) site (the SEPs). Investigations into the effectiveness of the ITS have been limited. Historical water flow and collection data for the ITS are nonexistent. Recent reports on the ITS (ASI, 1991; EG&G, 1993a) rely on data interpolation and computer modeling for evaluating ITS performance.

This evaluation will rely primarily upon ITS-specific data collected as part of the RCRA Facility Investigation/Remedial Investigation (RFI/RI) Phase I activities, and upon flow data to the Temporary Modular Storage Tanks (TMSTs). The data currently available indicate that the ITS is effective in collecting alluvial ground water where the ITS is keyed into bedrock. The following sections of this report present and analyze the data upon which this conclusion is based.

A.2 HISTORICAL REVIEW

Nitrate contamination of North Walnut Creek (located north of the SEPs) was documented in the early 1970s. In response to this contamination, a series of six trenches and two sumps was installed north of the SEPs as the original SEPs contaminant control system. These trenches and sumps intercepted natural seepage and pond leakage that would otherwise have entered North Walnut Creek, and were successful in reducing nitrate levels in North Walnut Creek (ASI, 1991). The contaminant control system was replaced with the larger and more elaborate ITS in April 1981. This ITS was installed because of construction of the fences around the Protected Area (PA) and the destruction of two of the earlier trenches. The ITS is still in use.

The ITS was designed primarily to collect subsurface water. Engineering drawings for the design and construction of the ITS are Rockwell International (RI) as-built Drawings 27550-033, 27550-040, 27550-050, 27550-200, 27550-201, and 27550-202. Although the ITS was much more extensive than the trench and sump system that it replaced, it became necessary to extend the ITS to the south shortly after construction of the system. Figures A-1 and A-2 depict the original ITS as well as its final configuration after the extension to the south (the Southern Extension). As-built drawings (RI Drawings 26637-01 and 26637-02) indicate that the Southern Extension was built between February and June, 1982.

The ITS was extended to the south because of concerns about ground water seeps immediately north of the SEPs which were causing elevated levels of nitrate contamination in some of the A-series drainage ponds to the north and east of the SEPs. These elevated nitrate concentrations were a source of concern to both the Colorado Department of Health (CDH) and to RI personnel at RFP. The Southern Extension of the ITS consisted of a french drain that paralleled the perimeter road and was designed and built with gravel backfill from the collection drain to the ground surface. This design allowed the Southern Extension to collect both ground water and surface water flows. The Southern Extension also provided for the collection of footing drain flows from Building 774 and possibly from Building 771 (near the western end of the Southern Extension) through a 4-inch-diameter polyvinyl chloride (PVC) pipe. This PVC pipe allowed gravity drainage from the sump of a pump station immediately northeast of the Building 774 Pond. The ITS pump station consists of a wet well and a duplex installation of pumps. When active, this pump station had pumped water collected in it to the SEPs. Electrical power to the pump was cut off when the Southern Extension of the ITS allowed gravity drainage from the Building 774 Pond area.

In summary, the ITS collects ground water and surface water runoff (from the area immediately north of the SEPs and south of the perimeter road) which drains by gravity to a pump station located near North Walnut Creek. Some additional surface water runoff is also collected by the ITS due to the routing of storm drains from the Building 779 area to the hillside south of the ITS Southern Extension.

From the time of its construction until May 1993, water collected by the ITS was pumped to SEP 207B-North. This pumped flow was not metered. In May 1993, the flow from the ITS was re-routed to the OU4 TMSTs located northwest of the SEPs. The new routing of the piping includes a flow meter which is monitored on a daily basis.

A.3 ITS CONFIGURATION AND DESIGN

A.3.1 System Components

In its current configuration, the ITS consists of 19 collection pipes that flow into two separate header pipes entering the ITS wet well. Pipes 1 through 7 flow to the eastern header pipe, while pipes 8 through 19 flow to the western header pipes. The Southern Extension to the ITS consists essentially of two pipes (eastern and western), that flow to a manhole which conveys the flow to pipe 12 of the ITS. Figure A-3 depicts the pipe numbering system and general layout of the ITS.

Water collected in the ITS flows by gravity to the pump house located near North Walnut Creek. The depths of the french drains comprising the ITS range from 1 to 27 feet below ground surface (bgs), with typical depths of 4 to 15 feet. The gravel-filled trenches of the french drains are approximately 1 foot wide, with perforated pipe in the bottom to intercept and transport ground water flow to the ITS pump house. These pipes are designed to collect primarily ground water. The trenches in which the pipes were installed are completed with topsoil at the surface to minimize the collection of storm water runoff and to allow for vegetative growth.

The ITS Southern Extension collects ground water, seep flow, and storm water runoff, and the flows are transferred to the ITS pump house. Engineering drawings indicate that the Southern Extension french drains vary in depth from 2.7 to 8 feet, have a width of approximately 13 inches, and have a flexible membrane liner on the downgradient side of the backfilled trench. The Southern Extension is approximately 1,500 feet in length, and is drained by a single 4-inch-diameter PVC pipe. The ITS Southern Extension drains were designed and built with a gravel backfill from the drain to the surface so that they would collect both ground water and surface water flow. The ITS Southern Extension slopes from both ends toward the center manhole. The manhole is drained by gravity through another 4-inch PVC pipe that connects to existing pipe 12 of the ITS. Pipe 12 flows to the western header pipe that feeds the ITS pump house wet well. Although storm water collection was a concern, the main concern that drove construction of the ITS Southern Extension was the collection of contaminated seep flows north of the SEPs. However, the design that allowed for collection of seep flows also allowed for collection of storm water flows in the areas of the seeps.

The areas tributary to the ITS when fully operative include the following:

- SEPs area ground water and storm water runoff,
- Hillside north of the SEPs and south of the drains,
- Building 779 storm water and footing drain flows, and,
- Building 771/774 footing drain flows along with limited storm water from the same area.

Storm water from the Building 779 area is routed through a 15-inch corrugated metal pipe (CMP) that outfalls on the hillside and is captured by the western portion of the ITS Southern Extension. Until recently, flows from the Building 771/774 area footing drains were also captured by the western-most end of the ITS Southern Extension. However, since the fall of 1992, the ITS has no longer been collecting the majority of these flows. Previously, flows into the ITS from this area were identifiable through visual inspection of the West Collector, a sump and former pump station installed at the western-most end of the ITS Southern Extension (ASI, 1991). The West Collector was hydraulically connected to a small pond immediately southwest of the sump, referred to as the Building 774 Pond. The West Collector provided drainage for the Building 774 Pond, keeping the water level of the pond below the pond berm. Flows in the West Collector were measured in 1990 and were presented in the 1991 ASI report.

Field observations of the West Collector in the fall of 1992 identified no flow through the West Collector into the ITS Southern Extension. There no longer appeared to be a hydraulic connection between the West Collector and the Building 774 Pond, although the reason for this change is unknown. The water level in the Building 774 Pond was considerably higher in the fall of 1992 than previously observed. During the spring and summer of 1993, the Building 774 Pond overtopped its berm and inundated the general area near the pond and the West Collector. No flows from the West Collector into the ITS Southern Extension were observed during site visits in 1993.

The lack of flow from the West Collector can have a significant impact on the total flows collected by the ITS. It had been estimated that flow from the West Collector could account for 22 percent of the total ITS flows (ASI, 1991). Data available in 1991 indicated that volatile organic compounds (VOCs) were detected in water from the Building 774 Pond area.

During storm events, the area near the Building 774 Pond and the West Collector drains to the east. This flow occurs in a ditch immediately south of the patrol road on the inside of (south of) the PA fenceline. The flows in this ditch eventually enter a 60-inch-diameter concrete culvert that flows to the north under the patrol road and under the PA fenceline. The flows in this culvert combine with flows in a 72-inch culvert carrying North Walnut Creek waters. This second culvert flows to the east where it surfaces above the A-series drainage ponds in the approximate location of surface water station SW-093.

Since April 15, 1993, flow from the ITS has been routed to the TMSTs and eventually transferred to either the flash evaporators in Building 910, or to the Building 374 process waste treatment system. There are three TMSTs north of the ITS. Each tank has a holding capacity of 500,000 gallons.

A.3.2 ITS Hydrology/Hydraulics

The ground water present in OU4 flows principally in two hydrostratigraphic units (HSU). The Upper HSU is composed primarily of alluvial material which includes the Rocky Flats Alluvium, valley fill alluvium and colluvium. In areas where the underlying Arapahoe Formation is sandstone, it is included in the Upper HSU because of the hydraulic connection. Ground water in the Upper HSU generally occurs under unconfined conditions.

The Lower HSUs at RFP include sandstone units of the Arapahoe Formation and the Laramie/Fox Hills aquifer that exist beneath RFP. Ground water in these aquifers may be confined by interbedded claystones and silty claystones.

Ground water in the SEPs area is generally controlled by the local topography. The SEPs are constructed on an east to west-trending topographic ridge flanked on the north and south by tributaries of Walnut Creek. Ground water flow in the Upper HSU materials is generally toward North Walnut Creek north of the SEPs and toward South Walnut Creek south of the SEPs. Ground water flow is generally believed to follow along the contact between the alluvium and the Arapahoe Formation claystones. The claystones have a low hydraulic conductivity, on the order of 1 x 10^{-7} centimeters per second (cm/s), effectively constraining much of the flow within the unconsolidated materials above the alluvial/bedrock contact. The hydraulic conductivity of the Rocky Flats Alluvium and the upper Arapahoe Sandstone is approximately 1 x 10^{-5} cm/s. The lower Arapahoe sandstones have a hydraulic conductivity of approximately 10^{-6} cm/s. Table A-1 lists the hydraulic conductivities of saturated formations present in the SEPs area.

Ground water flow in the SEPs area is influenced by recharge by precipitation, leakage from the SEPs, and drainage into the ITS. The amount of pumpage from the ITS has been estimated previously at a maximum of 4,100,000 gallons per year with annual flows of approximately 3,100,000 gallons (ASI, 1991).

The ITS is a duplex pump station. Prior to the construction of the TMSTs and the force main to fill the TMSTs, the ITS pump station was capable of pumping 80 gallons per minute (gpm) with one pump operating, and approximately 100 gpm with both pumps operating. Any incoming flows that exceed 100 gpm fill the wet well, increasing its potential for overflow. Historically, overflow of the wet well occasionally occurred during wet weather conditions. The pumping capacity of the ITS pump station was upgraded as part of the TMST modifications. Although the data record is short, the ITS wet well is not believed to have overflowed since ITS waters have been routed to the TMSTs. The current configuration of the ITS allows a maximum pumping rate of approximately 135 gpm with both pumps operating.

Evaluation of the ITS must include a hydraulic analysis of the capability of the system to convey ground water flows intercepted by the french drain pipes. The ITS is composed primarily of 4-inch-diameter PVC pipes. These pipes are generally sloped quite steeply downhill to the ITS wet well. The ITS french drain collection pipes downgradient of the Southern Extension are installed at an angle to ground water flow direction (Figure A-2). Because of the angled pipe configuration, ground water would have to escape capture by at least two french drain collection pipes to bypass the ITS. With the addition of the Southern Extension, there are at least three collection pipes past which ground water would have to flow in order to bypass the ITS. Thus, the ITS design has a safety factor incorporated into its design ensuring that if any one pipe becomes surcharged, there are additional collection pipes capable of collecting and conveying those flows.

TABLE A-1
SUMMARY OF HYDRAULIC PROPERTIES IN GEOLOGIC MEDIA NEAR SEPs

Source	Formation	Hydraulic Conductivity cm/s[a]
Ground Water Assessment Plan Addendum - Draft EG&G, 1990.	Valley Fill	9×10^{-3}
	Alluvium	$5.3 \times 10^{-4} - 2.1 \times 10^{-5}$
	Bedrock	$5.4 \times 10^{-7} - 4 \times 10^{-8}$
Hydrogeological Characterization of the Rocky Flats Plant, Hydro-Search, 1985.	Alluvium	1×10^{-3}
	Arapahoe Sandstone	4×10^{-5}
	Arapahoe Claystone	3×10^{-7}
Section E Ground Water Protection Rockwell International, 1986.	Rocky Flats Alluvium	7×10^{-5}
	Walnut Creek Alluvium	3×10^{-5}
	Woman Creek Alluvium	3×10^{-3}
	Arapahoe Sandstone	2×10^{-6}
	Weathered Arapahoe Claystone	5×10^{-7}
	Unweathered Arapahoe Claystone	1×10^{-7}
	Qal (Valley Fill)	2×10^{-4}
Draft Final Ground Water Protection and Monitoring Plan, EG&G, 1991.	Rocky Flats Alluvium Arapahoe Sandstone #1	6×10^{-5}
	Arapahoe Sandstone #3, 4, 5	10^{-6}
	Basal Arapahoe Sandstone	10^{-6}
	Arapahoe Claystone (Weathered and Unweathered)	$10^{-7} - 10^{-8}$
RCRA Part B Permit Application, Rockwell International, 1988.	Rocky Flats Alluvium	7×10^{-5}
	Valley Fill	3×10^{-3}
	Arapahoe Formation	$2 \times 10^{-6} \times 1 \times 10^{-7}$
Hydrology of a Nuclear-Processing Plant Site, Hurr, 1976.	Rocky Flats Alluvium	1×10^{-2}
	Valley Fill	NA
	Arapahoe Formation	1×10^{-4}
RCRA Post-Closure Care Permit Application, Rockwell International, 1988.	Rocky Flats Alluvium	$9 \times 10^{-6} - 4 \times 10^{-8}$
	Valley Fill	5×10^{-6}
	Arapahoe Formation	NA

a/ cm/s = centimeters per second

SOURCE: 1990 Annual RCRA Ground Water Monitoring Report (EG&G, 1991).
(References listed in table are given in the source report.)

A brief review of the ITS indicates potential problems with the ability of the ITS Southern Extension to convey intercepted ground water flows. The ITS Southern Extension is perpendicular to ground water flows and thus can intercept a greater quantity of ground water than any other single ITS pipe. Hydraulic analysis of the Southern Extension pipes indicates that the pipe connecting the Southern Extension manhole to pipe 12 of the original portion of the ITS is the hydraulically-limited pipe.

The connecting pipe from the Southern Extension manhole to pipe 12 has a length of 150 feet and a slope of either 0.005 or 0.015 foot-per-foot (ft/ft). Uncertainty exists as to the exact slope of the pipe because of conflicting information regarding the elevation of the southern end of pipe 12. Drawing 26637-01 indicates that the invert elevation at the southern end of pipe 12 is 5,925.5 feet, while Drawing 26637-02 indicates that the invert elevation at the southern end of pipe 12 is 5,924.0 feet. If the southern end of pipe 12 has the former invert elevation (5,925.5 feet), then the slope of the pipe connecting the Southern Extension manhole to pipe 12 is 0.005 ft/ft. On the other hand, if the southern end of pipe 12 has the latter invert elevation (5,924.0 feet) then the slope of the pipe connecting the Southern Extension manhole to pipe 12 is 0.015 ft/ft. With a slope of 0.005 ft/ft, this is pipe capable of conveying flows of up to 67 gpm when water in the ITS Southern Extension manhole is backed up to the bottom of the inlet pipes. Flows greater than 67 gpm can potentially cause water to back up into the collection pipes feeding the Southern Extension manhole.

Back-up of waters into these collection pipes could cause discharge from some of the collection pipes, allowing the waters to bypass the Southern Extension collection system. These high flows are most likely to occur during or immediately following precipitation events since the design of the Southern Extension allows for collection of surface water runoff. The data record for piezometers immediately downgradient of the ITS Southern Extension should be reviewed following major precipitation events to determine if surcharging of the Southern Extension pipe occurs. To date, the data do not indicate any surcharging of the Southern Extension pipe.

A.3.3 Area Characteristics

The ITS and its tributary areas are located in the North Walnut Creek drainage basin. A discussion of this drainage basin can be found in the "Rocky Flats Plant Drainage and Flood Control Master Plan" (Wright Water Engineers, 1992). The Walnut Creek drainage basin is located on a relatively flat surface of Rocky Flats Alluvium which decreases in thickness toward the east. However, the pediment surface and overlying alluvium have been eroded by Walnut Creek on the north and Woman Creek on the south, creating variable topographic and hydrologic characteristics across the Walnut Creek drainage basin. Closer to the stream bottoms, colluvium and valley fill materials are encountered, essentially consisting of eroded alluvial materials. In order to standardize nomenclature in this report, the term "unconsolidated materials" refers to those soils above bedrock consisting of Rocky Flats Alluvium, colluvium, and Valley Fill Alluvium.

The western portion of the basin slopes approximately two percent toward the east and center of the plant. These western soils have high infiltration rates. The center portion of the basin is highly eroded and contains gullies with up to 20 percent side slopes and 4 percent channel slopes leading into the Walnut Creek tributaries. Contact between the unconsolidated materials and the underlying Arapahoe Formation in this area has created seeps contributing to surface water runoff. These central soils have low infiltration rates (Wright Water Engineers, 1992). The eastern portion of the basin consists of broad valleys with approximately 5 percent side slopes and 2 percent channel slopes contributing to Walnut Creek. These eastern soils have a low to medium infiltration rate.

Most of the Walnut Creek drainage basin is undeveloped except for the highly developed RFP industrial area. The RFP industrial area is located over the original upland and steep gully portion of the basin. Development has changed the original land form to a generally flat area sloping gently to the east. The area is heavily developed, with high imperviousness (Wright Water Engineers, 1992). The relationship between rainfall and the resulting runoff is determined by topographic, geologic, soil, and physical characteristics of the drainage basin. Additional information and details on basin boundaries and aggregate characteristics of the Walnut Creek drainage basin can be found in the "Master Drainage Plan" (Wright Water Engineers, 1992).

Surface and ground water flows into the ITS are directly related to the rainfall-runoff relationship of the area tributary to the drain that intersects the ground surface. The tributary areas to ITS storm water flows include the hillside north of the SEPs and the Building 779 area. These areas are defined in the Rocky Flats Plant Drainage and Flood Control Master Plan (RFP MDP) as basins CWAC7 and CWAC9, respectively. Basin parameters, slightly modified to reflect the primary routing of surface runoff into the ITS (instead of into the storm water drain) and the reduction of Building 779 area runoff, were used to calculate the amount of runoff from Building 779 collected by the ITS (EG&G, 1993a). Characteristics of these sub-basins include paved areas and buildings; ditches and enclosed depressions; unpaved areas with low slope; and open, unpaved areas with high slope.

A.4 AVAILABLE WATER BALANCE DATA

Previous RFP studies (ASI, 1991) have developed water balances around the ITS using data compiled from historical records (including regional data compiled by outside agencies) and data from site-specific investigations. In this report, OU4-specific data derived from the 1992/1993 RFI/RI Phase 1 investigation were used to develop a water balance for the ITS. These data were then used to assess the ITS's efficiency in capturing ground water from unconsolidated materials.

EG&G's April 1993 "Interceptor Trench System Water Balance" study (EG&G, 1993a) and ASI's January 1991 "Solar Pond Interceptor Trench System Ground Water Management Study" (ASI, 1991) served as a foundation for development of the water balance. Data collected during the RFI/RI investigation (from December 1992 through December 1993) were used in this report to expand upon conclusions from these earlier studies. In particular, data on the elevation of top of bedrock as well as saturated and unsaturated conditions in the unconsolidated materials were generated as a portion of these RFI/RI activities. Data generated on saturated unconsolidated material conditions, as a part of the RFI/RI activities, were used to develop the quantity of ground water the ITS should collect, assuming 100-percent-efficient groundwater capture. These calculated quantities of water were then compared to the volumes of water actually pumped from the ITS pump house.

Since May 1993, a flow meter has generated data, on a daily basis, on volumes of water pumped from the ITS pump house. For a six-week period in June and July of 1993, the meter was inoperative due to a mechanical failure, and data are not yet available for early August to mid-September, 1993. The flow meter currently in use was installed as a portion of the activities related to construction of the TMST system. Prior to the installation of this meter, no accurate flow records were available for the ITS.

A.4.1 Precipitation

RFP generates data on precipitation and other weather conditions on a real-time basis from meteorological monitoring towers. Summary data on RFP precipitation have been compiled by EG&G's Air Quality Division and are included in Table A-2. These data include normal precipitation events from 1961 through 1990 and extreme precipitation events from 1953 through 1993. Precipitation at the RFP is typically most prevalent from March through September, with peaks in May. In addition to these summary data, daily precipitation data for RFP are included in Table A-3 for May through December, 1993. Comparison of Tables A-2 and A-3 reveals that the mean precipitation for May through December is normally 11.71 inches, but in 1993 the precipitation in this same period was only 8.40 inches. This relative lack of precipitation (72 percent of normal) should be reflected in smaller-than-normal quantities of water collected and pumped by the ITS for 1993.

TABLE A-2
NORMAL (1961-1990) AND EXTREME (1953-1993) MONTHLY PRECIPITATION AT THE ROCKY FLATS PLANT (IN INCHES)

Month	Mean	Maximum Monthly	Year	Maximum Annual (listed monthly)	Year
January	0.46	1.73	1959	0.25	1969
February	0.53	1.81	1959	0.12	1969
March	1.24	4.52	1983	0.79	1969
April	1.75	4.73	1973	1.02	1969
May	2.74	9.70	1969	9.70	1969
June	2.05	4.79	1969	4.79	1969
July	1.64	5.10	1965	2.22	1969
August	1.57	4.59	1982	0.49	1969
September	1.46	4.49	1976	0.11	1969
October	0.91	4.83	1969	4.83	1969
November	0.80	2.47	1983	0.81	1969
December	0.54	1.50	1958	0.54	1969
TOTAL	15.69			25.67	

EG&G. 1993a. *Interceptor Trench System Water Balance*, EG&G Internal Report, Submitted to the SEPs Project Office, by the Surface Water Division. April 13.

TABLE A-3
SOLAR PONDS -ITS SYSTEM
PUMPING AND PRECIPITATION DATA

DATE	READING	GALLONS PUMPED (X100)	(QUALIFIER)	PRECIPITATION (inches)
11-May-03	3200	Start		
12-May-93	3264	64		0.10
13-May-93	3316	52		
14-May-93	3316	51	*Averaged	0.01
15-May-93	3316	51	*Averaged	0.15
16-May-93	3316	51	*Averaged	0.06
17-May-93	3518	51	*Averaged	0.44
18-May-93	3699	181		0.04
19-May-93	3761	62		0.03
20-May-93	3835	74		
21-May-93	3897	62		
22-May-93	3945	48		
23-May-93	4005	60		
24-May-93	4052	47		0.12
25-May-93	4106	54		0.01
26-May-93	4159	53		
27-May-93	4214	55		
28-May-93	4261	47		0.01
29-May-93	NoData	48		
30-May-93	NoData	48		0.09
31-May-93	4405	48		
01-Jun-93	NoData	49		
02-Jun-93	4503	49		0.05
03-Jun-93	4553	50		0.07
04-Jun-93	4599	46		
07-Jun-93	Malfunction			0.08
16-Jun-93	Malfunction			0.02
17-Jun-93	Malfunction			1.15
18-Jun-93	Malfunction			0.42
11-Jul-93	Malfunction			0.10
12-Jul-93	Malfunction			0.03
13-Jul-93	4630	31		0.05
14-Jul-93	4660	30		0.23
15-Jul-93	4718	58		
16-Jul-93	4765	47		
17-Jul-93	4818	53		0.02
18-Jul-93	4852	34		
19-Jul-93	4889	37		
20-Jul-93	4929	40		
21-Jul-93	5011	82		
22-Jul-93	5057	46		
23-Jul-93	5102	45		
24-Jul-93	No Data	40	*Averaged	
25-Jul-93	No Data	40	*Averaged	
26-Jul-93	5221	40	*Averaged	
27-Jul-93	No Data	39	*Averaged	
28-Jul-93	No Data	39	*Averaged	

Source: EG&G 1993, ITPH data sheets

TABLE A-3
SOLAR PONDS -ITS SYSTEM
PUMPING AND PRECIPITATION DATA

DATE	READING	GALLONS PUMPED (X100)	(QUALIFIER)	PRECIPITATION (inches)
29-Jul-93	5337	39	*Averaged	
30-Jul-93	5377	40		0.03
31-Jul-93	5410	33		
01-Aug-93	5430	20		
02-Aug-93	5462	32		
03-Aug-93	5489	27		
04-Aug-93	No Reading			0.05
05-Aug-93	No Reading			0.14
06-Aug-93	No Reading			0.10
12-Aug-93	No Reading			0.02
17-Aug-93	No Reading			0.03
20-Aug-93	No Reading			0.04
21-Aug-93	No Reading			0.03
13-Sep-93	6600	Start		0.57
14-Sep-93	6727	127		
15-Sep-93	6792	65		
16-Sep-93	6827	35		0.01
17-Sep-93	6851	24		0.05
18-Sep-93	No Data	13	*Averaged	0.20
19-Sep-93	6876	13	*Averaged	
20-Sep-93	6876	0		
21-Sep-93	6923	47		
22-Sep-93	6967	44		0.03
23-Sep-93	6999	32		0.01
24-Sep-93	No Data	43	*Averaged	
25-Sep-93	7085	43	*Averaged	
26-Sep-93	7119	34		
27-Sep-93	7152	33		
28-Sep-93	7189	37		
29-Sep-93	7226	37		
30-Sep-93	7257	31		
01-Oct-93	7294	37		
02-Oct-93	7326	32		
03-Oct-93	7356	30		
04-Oct-93	No Data	32	*Averaged	
05-Oct-93	No Data	32	*Averaged	
06-Oct-93	No Data	32	*Averaged	
07-Oct-93	7484	32	*Averaged	0.15
08-Oct-93	7515	31		0.02
09-Oct-93	7557	42		0.04
10-Oct-93	7587	30		
11-Oct-93	7626	39		
12-Oct-93	7663	37		
13-Oct-93	7700	37		
14-Oct-93	7730	30		0.01
15-Oct-93	7767	37		
16-Oct-93	No Data	127	*Averaged	

Source: EG&G 1993, ITPH data sheets

TABLE A-3
SOLAR PONDS -ITS SYSTEM
PUMPING AND PRECIPITATION DATA

DATE	READING	GALLONS PUMPED (X100)	(QUALIFIER)	PRECIPITATION (inches)
17-Oct-93	No Data	127	*Averaged	0.61
18-Oct-93	8147	127	*Averaged	0.04
19-Oct-93	8232	85		
20-Oct-93	8258	26		0.01
21-Oct-93	8309	51		
22-Oct-93	8353	44		
23-Oct-93	8397	44		
24-Oct-93	8439	42		
25-Oct-93	No Data	42	*Averaged	0.02
26-Oct-93	No Data	42	*Averaged	
27-Oct-93	8564	42	*Averaged	
28-Oct-93	8602	38		0.34
29-Oct-93	8646	44		0.17
30-Oct-93	No Data	103	*Averaged	
31-Oct-93	8851	103	*Averaged	
01-Nov-93	8955	104		0.15
02-Nov-93	9048	93		
03-Nov-93	9148	100		
04-Nov-93	No Data	68	*Averaged	0.17
05-Nov-93	9284	68	*Averaged	0.01
06-Nov-93	9376	92		
07-Nov-93	9454	78		
08-Nov-93	9518	64		
09-Nov-93	9575	57		
10-Nov-93	9630	55		
11-Nov-93	9683	53		
12-Nov-93	9740	57		0.23
13-Nov-93	9825	85		0.05
14-Nov-93	No Data	86	*Averaged	0.50
15-Nov-93	9997	86	*Averaged	
16-Nov-93	10127	130		
17-Nov-93	10237	110		
18-Nov-93	10332	95		
19-Nov-93	10457	125		
20-Nov-93	No Data	84	*Averaged	
21-Nov-93	No Data	84	*Averaged	
22-Nov-93	10708	84	*Averaged	
23-Nov-93	10793	85		0.09
24-Nov-93	10863	70		0.07
25-Nov-93	10933	70		
26-Nov-93		64	*Averaged	
27-Nov-93	11060	64	*Averaged	
28-Nov-93		61	*Averaged	
29-Nov-93	11181	61	*Averaged	
30-Nov-93	11254	73		
01-Dec-93	11327	73		
02-Dec-93	11390	63		

Source: EG&G 1993, ITPH data sheets

TABLE A-3
SOLAR PONDS -ITS SYSTEM
PUMPING AND PRECIPITATION DATA

DATE	READING	GALLONS PUMPED (X100)	(QUALIFIER)	PRECIPITATION (inches)
03-Dec-93	11453	63		
04-Dec-93	11516	63		
05-Dec-93	11572	56		
06-Dec-93	11629	57		
07-Dec-93	11685	56		
08-Dec-93	11735	50		
09-Dec-93	11792	57		
10-Dec-93	11849	57		
11-Dec-93	11905	56		
12-Dec-93	11962	57		0.07
13-Dec-93	12019	57		
14-Dec-93	12069	50		
15-Dec-93	12119	50		
16-Dec-93	12167	48		0.04
17-Dec-93	12222	55		
18-Dec-93	12272	50		
19-Dec-93	12316	44		0.10
20-Dec-93	12367	51		
21-Dec-93	12410	43		0.13
22-Dec-93	12460	50		
23-Dec-93	12508	48		0.01
24-Dec-93	12542	34		Precip. Readings ended
25-Dec-93	12586	44		
26-Dec-93	12636	50		
27-Dec-93	12679	43		
28-Dec-93	12723	44		
29-Dec-93	12767	44		
30-Dec-93	12811	44		
31-Dec-93	12854	43		
01-Jan-94	12892	38		
02-Jan-94	12936	44		
03-Jan-94	12979	43		
04-Jan-94	13016	37		
05-Jan-94	13060	44		
06-Jan-94	13103	43		
07-Jan-94	13146	43		
08-Jan-94	13177	31		
09-Jan-94	13215	38		
10-Jan-94	13247	32		
11-Jan-94	13277	30		
12-Jan-94	13314	37		

Source: EG&G 1993, ITPH data sheets

A.4.2 Runoff

The Southern Extension of the ITS collects storm water runoff. Estimates of the amount collected have been made using typical principles of storm water engineering (EG&G, 1993a). Estimates of ITS inflow based on summary precipitation are listed in Tables A-4, A-5, and A-6. It is important to note that these flow estimates are based on calculations of runoff and assumed ITS collection efficiencies, rather than on empirical flow data collected from the ITS. Figure A-4 includes expected runoff hydrographs for RFP two-hour storm events (for 0.5 inch to 3.5 inches of precipitation in 0.5-inch increments). The storm water runoff from the Building 779 area alone has been identified in previous studies as a major contributor (approximately 700,000 gallons per year for an average year, or 36 percent of total ITS flow) to the overall volume of water collected by the ITS (EG&G, 1993a). Runoff modeling shows that for storm events of less than 0.25 inch per 2 hours, no appreciable runoff is generated for the total area (including both the hillside north of the SEPs and the Building 779 area) tributary to the ITS (EG&G, 1993). A more complete explanation of the assumptions and evaluations used to develop the above-referenced hydrographs and statements are contained in the "Interceptor Trench System Water Balance" report (EG&G, 1993a).

Flow data from the ITS are available, including storm water runoff data. Section A.4.5 of this report discusses the conclusions and observations drawn from the combined precipitation records and ITS flow records for May, June, and July of 1993.

TABLE A-4
INTERCEPTOR TRENCH SYSTEM WATER BALANCE (APRIL 13, 1993)
MAXIMUM TMST[a/] INFLOW BASED ON MEAN ANNUAL PRECIPITATION

	Mean Monthly Precipitation (inches)	**Maximum Surface Runoff Inflow to TMST (1,000 gallons)**	**Average Ground Water Inflow to TMST (1,000 gallons)**	**Total Inflow to TMST (1,000 gallons)**
January	0.46	28	60	88
February	0.53	32	80	112
March	1.24	74	101	175
April	1.75	105	122	227
May	2.74	164	119	283
June	2.05	123	111	234
July	1.64	98	99	197
August	1.57	94	92	186
September	1.46	88	91	179
October	0.91	55	74	129
November	0.80	48	56	104
December	0.54	32	47	79
TOTAL	15.69	941	1,052	1,993

a/ TMST = Temporary Modular Storage Tank

EG&G. 1993a. *Interceptor Trench System Water Balance*, EG&G Internal Report, Submitted to the SEPs Project Office, by the Surface Water Division. April 13.

TABLE A-5
INTERCEPTOR TRENCH SYSTEM WATER BALANCE (APRIL 13, 1993)
MAXIMUM TMST[a/] INFLOW BASED ON MAXIMUM ANNUAL PRECIPITATION

	Maximum Annual Precipitation	Maximum Surface Runoff Inflow to TMST (1,000 gallons)	Average Ground Water Inflow to TMST (1,000 gallons)	Total Inflow to TMST (1,000 gallons)
January	0.25	15	60	75
February	0.12	7	80	87
March	0.79	47	101	148
April	1.02	61	122	183
May	9.70	582	119	701
June	4.79	287	111	398
July	2.22	133	99	232
August	0.49	29	92	121
September	0.11	7	91	98
October	4.83	290	74	364
November	0.81	49	56	105
December	0.54	32	47	79
TOTAL	25.67	1,540	1,052	2,592

a/ TMST= Temporary Modular Storage Tank

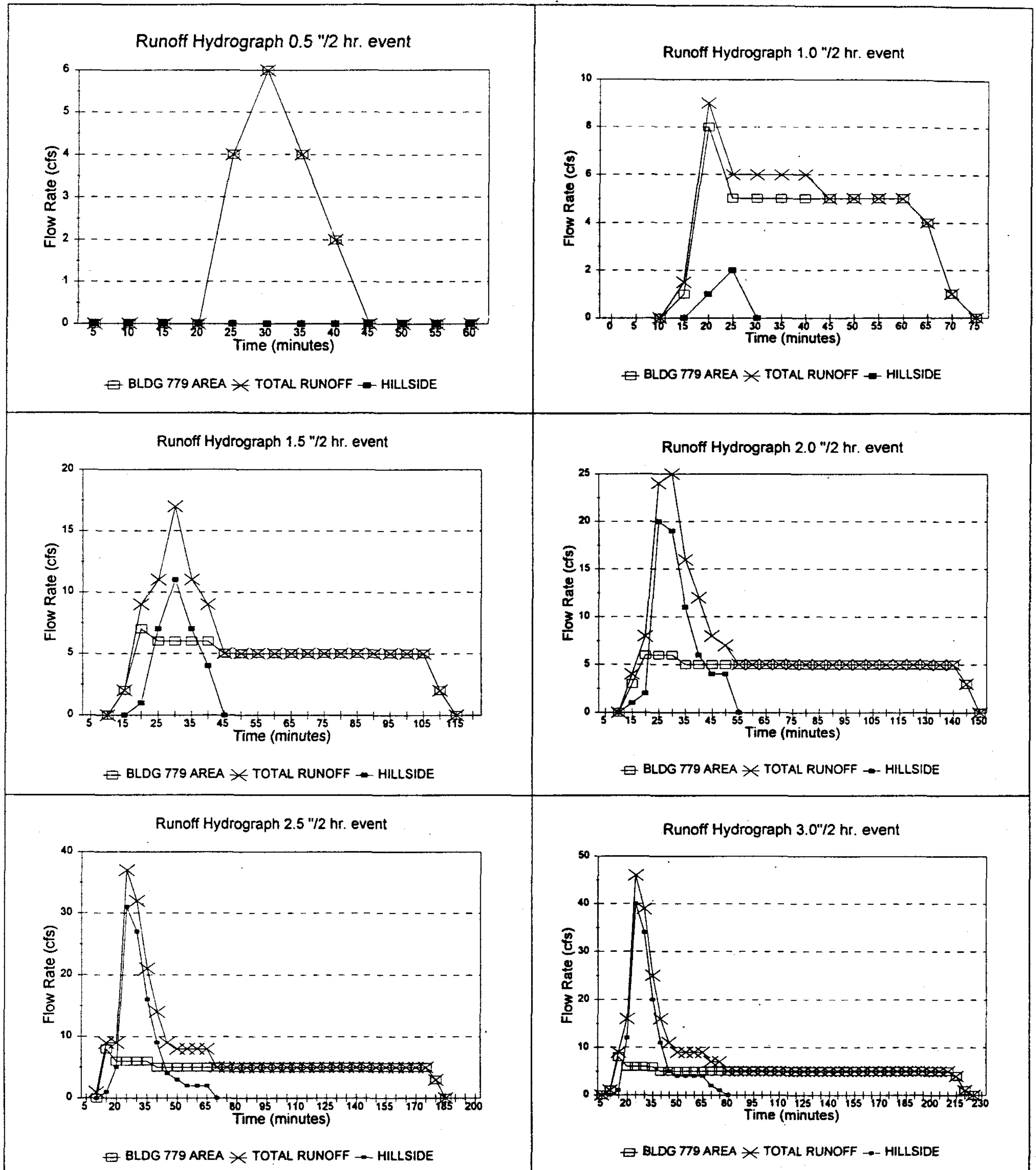
EG&G. 1993a. *Interceptor Trench System Water Balance*, EG&G Internal Report, Submitted to the SEPs Project Office, by the Surface Water Division. April 13.

TABLE A-6
INTERCEPTOR TRENCH SYSTEM WATER BALANCE (APRIL 13, 1993)
MAXIMUM TMST[a/] INFLOW BASED ON MAXIMUM MONTHLY PRECIPITATION

	Maximum Monthly Precipitation (inches)	Maximum Surface Runoff Inflow to TMST (1,000 gallons)	Average Ground Water Inflow to TMST (1,000 gallons)	Total Inflow to TMST (1,000 gallons)
January	1.73	104	60	164
February	1.81	109	80	189
March	4.52	271	101	372
April	4.73	284	122	406
May	9.70	582	119	701
June	4.79	287	111	398
July	5.10	306	99	405
August	4.59	275	92	367
September	4.49	269	91	360
October	4.83	290	74	364
November	2.47	148	56	204
December	1.50	90	47	137
TOTAL	50.26	3,016	1,052	4,068

a/ TMST = Temporary Modular Storage Tank

EG&G. 1993a. *Interceptor Trench System Water Balance*, EG&G Internal Report, Submitted to the SEPs Project Office, by the Surface Water Division. April 13.



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ROCKY FLATS PLANT
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Figure A-4
STORM WATER RUNOFF
HYDROGRAPHS

A.4.3 Infiltration

Infiltration through the vadose zone at OU4 occurs primarily from late winter through early spring when precipitation exceeds bare soil evaporation and plant transpiration. Therefore, recharge through the vadose zone is seasonal and only occurs during this period. Infiltration probably occurs through macropores and through interstitial flow in localized soil areas of higher hydraulic conductivity. This is evidenced by the relatively rapid response of the water table to a precipitation event observed at some of the piezometer locations at OU4. When deep infiltration occurs, variably-saturated vadose zone flow is generally vertically downward from ground surface to the unconfined ground water table. Ground water recharge by interstitial infiltration is estimated for OU4 at 9×10^{-3} inches/year. The ITS response to infiltration appears to be dependent upon the magnitude of the precipitation event. The ITS pumped flow does not appear to increase following minor (less than 0.2 inch in a day) precipitation events.

A.4.4 Unconsolidated Materials Ground Water Quantities

The ITS was originally designed to collect contaminated ground water from the unconsolidated materials and thus help protect the water quality of North Walnut Creek. To collect all ground water from unconsolidated materials, the ITS would have to be constructed at the base of the unconsolidated materials ground water system with sufficient hydraulic capacity to convey all intercepted ground water flows. Thus, a basic step in evaluation of the effectiveness of the ITS is an assessment of where the system is keyed into the bedrock.

Migration of contaminants in the Upper HSU at RFP are of much greater concern than migration of contaminants in the lower HSU (ie. unweathered bedrock) because the Upper HSU typically has hydraulic conductivities one or two orders of magnitude greater than the Lower HSU ground water system. If the ITS is keyed into unweathered claystone bedrock, then it could be effective in collecting all Upper HSU ground water. Where the ITS is not keyed into bedrock, it cannot be effective in collecting all Upper HSU ground water. Upgrades to the ITS should be considered if ground water is known or suspected to contain contamination in areas where the system is not keyed into bedrock or is keyed into sandstone bedrock. At the current time, many of the areas where the ITS is expected to be above the top of bedrock have few or no ground water monitoring wells. Monitoring wells are proposed in the Phase II work plan in areas where the ITS is expected to be above bedrock. These wells can be used to further assess the presence and quality of ground water in those areas.

To evaluate if the ITS is keyed into bedrock, the invert elevations on the as-built drawings for the ITS were compared with the draft top-of-bedrock elevation map. The results of this comparison are presented in Table A-7. Because information had to be manually transferred from a number of different sources to obtain the desired information, and because many of the values were interpolated between known data points, the tabulated values should be considered approximations. The source drawings for the pipe invert elevations were Drawings 277550-033 for pipes 1 through 6, 27550-040 for pipes 6 through 18, and 27550-050 for pipes

TABLE A-7
COMPARISON OF INTERCEPTOR TRENCH SYSTEM CONSTRUCTION DETAIL WITH BEDROCK ELEVATION

Pipe Number	Location on Pipe	Depth to Pipe (feet)	Depth to Bedrock (feet)	Bedrock Depth-Pipe Depth (feet)[a]
1	Northernmost Extent	13	27	14
	Southernmost Extent	13	14	1.0
	Center Dog Leg	20	8	-12
2	Northernmost Extent	12	20	8
	Southernmost Extent	6.5	17	10.5
	Center Dog Leg	10	18	8
3	Northernmost Extent	9.5	20	10.5
	Southernmost Extent	17	17	0
4	Northernmost Extent	15.6	22	6.4
	Southernmost Extent	14	14	0
5	Northernmost Extent	18.7	18	-0.7
	Southernmost Extent	3	16	13
6	Northernmost Extent	20	12	-8
	Southernmost Extent	3.5	2	-1.5
7	Northernmost Extent	15	12	-3
	Southernmost Extent	4.5	1	-3.5
8	Northernmost Extent	7	10	3
	Southernmost Extent	4	2	-2
9	Southernmost Extent	5.5	3	-2.5
10	Southernmost Extent	5	1	-4
11	Southernmost Extent	1	2	1
12	Northernmost Extent	3	10	7
	Southernmost Extent	0?	0	0
13	Northernmost Extent	16	28	12
	Southernmost Extent	4	-2[b]	-6[c]
14	Northernmost Extent	27	8	-19
	Southernmost Extent	3.5	0[b]	-3.5
15	Northernmost Extent	12.5	2	-10.5
	Southernmost Extent	1.5	0[b]	-1.5
16	Northernmost Extent	5	5	0
	Southernmost Extent	2	0[b]	-2
17	Northernmost Extent	8.5	6	-2.5
	Southernmost Extent	3.5	0[b]	-3.5
18	Northernmost Extent	8	20	12
	Southernmost Extent	2	4	2
19	Northernmost Extent	7	14	7
	Southernmost Extent	6	1	-5
Southern Extension	East End	4	1	-3
	Center (Manhole)	5.7	0[b]	-5.7
	West End of French Drain	2.6	4	1.4

[a] Positive number indicates bedrock is deeper than pipe; negative number indicates pipe penetrates bedrock.
[b] Available data indicates bedrock at ground surface.
[c] Results are questionable, and require additional evaluation.

18 and 19. Elevations of the Southern Extension of the ITS were taken from Drawings 26637-01 and 26637-02. Results of this evaluation are depicted on Figure A-5.

This preliminary ITS evaluation was part of the Phase I RFI/RI field investigation program. A number of piezometers were installed to generate site-specific information for evaluation of the effectiveness of the ITS. The objectives of this investigation generally included identification and monitoring of the unconsolidated materials ground water elevation in the vicinity of the ITS, identification of bedrock elevations relative to the ITS, development of information on hydraulic characteristics of the unconsolidated materials through the drawdown curves into the ITS, and estimation of ground water flow directions. The piezometers and boreholes installed for assessment of the ITS included the strings of piezometers identified below. These piezometers and boreholes are identified on Figure A-6.

Piezometer String PZ01:

This piezometer string straddles the eastern pipe of the ITS Southern Extension, and is in the area of old Trench #2. The ITS appears to be keyed into bedrock in this area. The piezometers that make up this string are 46093 (downgradient of the ITS Southern Extension), 46193 (upgradient of the ITS Southern Extension and downgradient of old Trench #2), and 46293 (upgradient of both the ITS Southern Extension and old Trench #2). Piezometer 46093 should be dry if the ITS is keyed into bedrock in this area and desaturating the unconsolidated materials. The invert elevation of the ITS Southern Extension at this point should be approximately 5931.6 feet.

Piezometer 46093: Based on April through late September 1993 water level measurements, this piezometer has been dry (no water in the sump to activate the water level measurement instrument). No bedrock elevation data are available for this hole because no core was collected (the piezometer was pushed into place). This piezometer does indicate that no water was present at an elevation of 5,925.6 feet (the bottom of the well screen) which is below the expected top of bedrock elevation. The bottom of the screen at piezometer 46093 is approximately 7 feet bgs at an elevation of 5,925.6 feet. The top of bedrock in the next nearest piezometer, 46193, is 2.2 feet bgs, at an elevation of 5933.5 feet. The data from piezometer 46093, along with data from other piezometers in string PZ01, indicate that the ITS appears to be effective in collecting the unconsolidated materials ground water near this piezometer.

Piezometer 46193: This piezometer had water levels below the bottom of the screen in April 1993, with the water level steadily increasing to an elevation 0.9 feet above bedrock in late July. The data record ends in late July. However, whenever saturated unconsolidated materials were present in this piezometer, the piezometer to the north (46093) indicated desaturated conditions. Therefore, it appears that all unconsolidated materials ground water upgradient of the ITS in the general area of piezometer string PZ01 is effectively collected by the ITS. Top of bedrock elevation (5,933.5 feet) in this piezometer is approximately 4.8 feet above the bottom of the screen and 2.2 feet bgs.

Piezometer 46293: Based on April to November, 1993 water level measurements, unconsolidated materials were saturated near this piezometer for most of the period. However, piezometer 46093 indicated dry conditions downgradient of the ITS throughout the period of record. Therefore, it appears that the ITS is effective in collection of all unconsolidated materials ground water in this area. Top of bedrock elevation at piezometer 46293 equalled the bottom of the screen elevation at 5,931.6 feet.

Piezometer String PZ02:

This piezometer string straddles the ITS eastern header pipe. This string includes piezometers 46393 (downgradient of the ITS), 40193 (downgradient of pipe 6 of the ITS and upgradient of the ITS eastern header pipe), and 46493 (upgradient of pipe 6 of the ITS). The ITS appears to be keyed into bedrock in this area. Piezometers 40193 and 46493 should both be dry if the ITS is keyed into bedrock in this area and desaturating unconsolidated materials. The invert elevation of the eastern header pipe at this point should be 5,883 feet, and the invert of pipe 6 should be 5,890 feet.

Piezometer 46393: April 1993 water level measurements in this piezometer showed water present in the sump, but not above the bottom of the screen. Thus, this well indicates that the unconsolidated materials were "dry" at that time. However, the water level in this piezometer steadily increased with time until early October, when there were approximately 3.4 feet of saturated aquifer materials. The bottom of the screen for this piezometer is located at an elevation of 5,877.9 feet, just below the top of bedrock, which occurred at 5,878.4 feet. Therefore, this piezometer can accurately identify if the unconsolidated materials are saturated. The piezometer is located downgradient of the eastern header pipe of the ITS, indicating water is present in unconsolidated materials at this point. Reasons for the presence of water are unclear, but may be due to a leak in the eastern header pipe, or related to a slump feature identified in the area which could contribute to unusual water level fluctuations.

Piezometer 40193: Based on April through November 1993 water level measurements, this piezometer was completely dry. Thus, this piezometer is considered to demonstrate "dry" conditions in the unconsolidated materials due to collection of ground water by the ITS. The bottom of this piezometer screen is located at 5,880.7 feet, just below the top of bedrock, which is at 5,881.3 feet. Thus, this piezometer can accurately indicate if the unconsolidated materials are saturated at this location.

Piezometer 46493: The April through late September, 1993 water level measurements for this piezometer have indicated that it is dry. This piezometer is considered to demonstrate "dry" conditions in the unconsolidated materials due to collection of ground water by the ITS. The bottom of the screen for this piezometer is completed at the top of bedrock (5,887.3 feet). Therefore, this piezometer can accurately indicate if saturated conditions exist in unconsolidated materials at this location.

Piezometer String PZ03:

This piezometer string is installed within the interior of the eastern portion of the ITS. This string includes piezometers 45393 (located within the ITS, immediately west [upgradient] of pipe 6, and east [downgradient] of pipe 7), 45293 (located within the ITS, immediately east [downgradient] of pipe 6), 44893 (midway between pipes 5 and 6, downgradient of pipe 5 and upgradient of pipe 6), 44993 (immediately west [upgradient] of pipe 5), and 45093 (immediately east [downgradient] of pipe 5). ITS pipe 6 should be keyed into bedrock in this area. Pipe 5 should be completely out of bedrock in this area. If the ITS is keyed into bedrock, then piezometer 45393 should be dry with respect to ground water. The other piezometers possibly may have ground water present. The invert elevation of pipe 5 at this point should be 5,916 feet, while the invert elevation for pipe 6 should be 5,905 feet. This piezometer string was sited partly to investigate the possible existence of a paleochannel in this area. The piezometer string was to straddle this paleochannel which trends to the northeast. Piezometer 44893 was located to intersect the center of the expected paleochannel.

Piezometer 45393: This piezometer was dry during April through late September, 1993 water level measurements. Because bottom of the screen for this piezometer is located at the top of bedrock (5,907.0 feet), it can accurately indicate saturated conditions in unconsolidated materials. Thus, this piezometer is considered to indicate that the unconsolidated materials are unsaturated.

Piezometer 45293: This piezometer had no water above the bottom of its screen during the period of record. The bottom of the screen for this piezometer is located at 5,912.3 feet, which is also the top of the bedrock surface. Thus, this piezometer indicates the presence of desaturated unconsolidated materials in the vicinity.

Piezometer 44893: Based on April 1993 water level measurements, 3.90 feet of saturated unconsolidated materials were present at this piezometer. From that time until the end of the data record in early November 1993, the thickness of saturated unconsolidated materials typically decreased with each successive sampling. However, this piezometer cannot be used to fully indicate unsaturated conditions in the unconsolidated materials since 2.2 feet of unmonitored aquifer materials exist below the bottom of the screen. The bottom of the screen for this piezometer is located at 5,911.8 feet, while the top of bedrock is located at 5,909.6 feet. It is believed that this piezometer was drilled through a paleochannel that is oriented downgradient to the northeast. This paleochannel is evidenced by the lower elevation of the top of bedrock in piezometer 44893 compared to the nearest piezometers (45293 and 44993). It appears that the bottom of this paleochannel could be passing beneath the ITS system pipes. This paleochannel could be a pathway for migration of contaminants past the ITS system. Thus, the existence of ground water in piezometer 44893 could be indicative of this contaminant migration pathway.

Piezometer 44993: Based on the data record from April to late September 1993, the water level measured in this well was below the bottom of the well screen. Thus, this piezometer indicates that the unconsolidated materials are unsaturated. Since the bottom of the well screen is at the top of bedrock (5,914.2 feet), this piezometer can accurately indicate unsaturated conditions in the unconsolidated materials.

Piezometer 45093: Based on a data record from April to late September 1993, the water level measured in this well was typically below the bottom of the well screen. However, this piezometer cannot be used to accurately identify if unconsolidated materials are unsaturated since the bottom of the screen (5,916.3 feet) is above the top of the bedrock surface (5,916.0 feet).

Piezometer String PZ04:

This piezometer string is located on the western half of the ITS Southern Extension. The piezometers that make up this string are 45593 (immediately downgradient of the ITS Southern Extension), 45693 (immediately upgradient of the ITS Southern Extension), 45793 (upgradient of the ITS Southern Extension), 45893 (upgradient of the ITS Southern Extension), and 45993 (upgradient of the ITS Southern Extension). The ITS should be keyed into bedrock in this area. Therefore, piezometer 45593, located immediately downgradient of the ITS Southern Extension, should be dry with respect to the presence of unconsolidated materials ground water. Piezometers 45793, 45893, and 45993 were placed far enough upgradient from the ITS Southern Extension so that no alluvial ground water table depression, due to ITS influence, should have been evident. Furthermore, the three latter piezometers were located to intersect or straddle what appeared to be a historic drainage present in this area. The historic drainage is based on aerial photography that pre-dated existence of the SEPs. Thus, piezometers 45793, 45893, and 45993 were located for the development of both top of bedrock elevations as well as ground water elevations. The invert elevation of the ITS Southern Extension at this point should be 5,930.5 feet.

Piezometer 45593: April through late September 1993 water level measurements in this piezometer indicate water levels below the base of the screen. Therefore, this well is thought to demonstrate that the unconsolidated materials are unsaturated. Bedrock elevation data for this piezometer is not available because the well screen was pushed, not drilled, into place. The bottom of the screen for it is located at an elevation of 5,928.0 feet, which is at a depth of 5.5 feet. Piezometer 45693 is the next nearest piezometer. Bedrock in 45693 occurs at a depth of approximately 0.8 feet. It is estimated that the depth to bedrock at piezometer 45593 would be similar to the depth to bedrock at 45693.

Piezometer 45693: Water level measurements during April and May 1993 indicate up to 6.0 feet of saturated unconsolidated materials near this piezometer. The available data indicate that since August 1993, the thickness of saturated unconsolidated materials has increased considerably. However, this piezometer is upgradient of the ITS. Data from piezometer 45593, downgradient of the ITS, indicates essentially complete collection of unconsolidated materials ground water by the ITS whenever saturated unconsolidated materials are noted in piezometer 45693. The top of bedrock at piezometer 45693 occurred at 5,935.8 feet. The bottom of this piezometer screen was installed at an elevation of 5,931.3 feet.

Piezometer 45793: The water level measurements at this piezometer have typically indicated that the water level in this piezometer has been below the bottom of the screen. The bottom of the screen for this piezometer is at the top of bedrock elevation (5,946.4 feet). This piezometer can be used to determine if the unconsolidated materials are unsaturated. However, due to its distance from the ITS Southern Extension, piezometer 45793 cannot be used to determine if the ITS Southern Extension is in fact desaturating alluvial materials. This piezometer is located far enough from the ITS collection that it would be expected to have water present in it from other sources, regardless of the effectiveness of the ITS system.

Piezometer 45893: This piezometer is approximately 125 feet upgradient of the ITS Southern Extension. Given this separation from the ITS, it is expected that saturated alluvium could occur at this piezometer even if the ITS were fully effective. However, all water level measurements for this piezometer have indicated water levels below the top of bedrock surface. The top of bedrock at this piezometer occurred at an elevation of 5,951.4 feet, and the bottom of the piezometer screen was placed at an elevation of 5,942.4 feet.

Piezometer 45993: The first water level measurement taken at this well on April 9, 1993 indicated that approximately 2.59 feet of saturated unconsolidated materials were present. The measured water level in the piezometer dropped quickly, with water essentially at the bottom of the screen by April 22, 1993, and typically below the bottom of the screen thereafter. The bottom of the screen for this piezometer is at 5945.7 feet, which is above the top of bedrock surface, at 5,945.4 feet. However, due to its distance from the ITS Southern Extension, piezometer 45993 cannot be used to determine if the ITS Southern Extension is in fact desaturating alluvial materials. It is expected that at times this piezometer should reflect saturated unconsolidated materials.

The results from these piezometer strings largely support the earlier findings regarding where the ITS was keyed into bedrock. The piezometers that were dry should have been dry if the ITS was keyed into bedrock and collecting unconsolidated materials ground water. Other reports have documented the extent of the desaturated unconsolidated materials created by the ITS (see Figures 4-34 and 4-35 in the "Final Ground water Assessment Plan" [EG&G, 1993a]). Similarly, estimates of bedrock elevations were also generally supported by the more specific bedrock elevation data generated from these piezometers. The data from the piezometers also allow for a more detailed evaluation of the quantities of ground water that should be collected by the ITS.

Based on the analysis of the locations in which the ITS is keyed into bedrock, the ITS should intercept ground water flow over a 1,400-foot length, perpendicular to overall ground water flow direction. This 1,400-foot length was determined from the area in which the ITS was keyed into bedrock, extending from the farthest western extent of the ITS east to approximately 210 feet east of the eastern edge of the 207B-Series SEPs (Figure A-5). The total amount of ground water collected on a given day can be estimated from the cross-sectional area of the ground water flow collected, and can be used to further determine the possibility that the ITS is collecting all ground water flow.

Saturated unconsolidated materials thicknesses immediately upgradient of the ITS were obtained from piezometers 45693, 45793, 45893, 45993, 46193, and 46293. These are piezometers in strings PZ01 (46193 and 46293) and PZ04 (45693, 45793, 45893, and 45993). Of these piezometers, those further south should reflect "naturally" saturated unconsolidated materials. Piezometers located closer to the ITS may be within the drawdown curve near the ITS french drains. Therefore, these piezometers would underestimate the amount of saturated unconsolidated materials present farther away from the ITS. The data on saturated unconsolidated materials from these piezometers were used to calculate the amount of ground water that should have been collected by the ITS on the chosen dates.

In all cases, piezometer 46293 recorded the maximum thickness of saturated unconsolidated materials, and this saturated thickness was extrapolated across the entire cross-sectional flow area east of that piezometer. The eastern end of the area in which the ITS is keyed into bedrock has numerous monitoring wells, but none of the wells is completed in unconsolidated materials. The average unconsolidated materials saturated thickness to the east is based on averaged data at piezometer 46293, unless the saturated thickness there exceeded 1 foot. The far eastern end of the Southern Extension of the ITS has approximately 1 foot of alluvium present, so the average saturated thickness for that area is averaged based on this maximum saturated thickness. To the west of piezometer 46293, the average saturated thickness of the unconsolidated materials was estimated with data from piezometers 45693 and 46293.

The hydraulic conductivity of the unconsolidated materials was conservatively assumed at the maximum reported value in the OU4 area, 3×10^{-4} cm/s. The slope of the water table was assumed to be 0.1 ft/ft. Five dates were selected to represent different prevailing conditions, and also were chosen as non-precipitation days. The ITS will collect considerable quantities of storm water runoff on precipitation days and immediately following precipitation days. Snowmelt in particular could account for storm water collection by the ITS over an extended period. It is difficult to quantify the exact amount of storm water runoff the ITS collects.

Estimates of the amount of ground water that should have been collected on five separate dates are presented in Table A-8. Also presented in Table A-8 is the amount of water pumped out of the ITS wet well for those dates. ITS flow measurements are discussed in more detail in the following section of this report. In all cases, the ITS collected more water than necessary to account for maximized estimates of the amount of ground water it should have collected.

TABLE A-8
COMPARISON OF COLLECTED GROUND WATER FLOWS WITH ITPH[a/] SYSTEM-PUMPED FLOWS

Date	Saturated Uncons. Mat. Thickness - Piezometer 45693 (feet)	Saturated Uncons. Mat. Thickness Piezometer 46293 (feet)	Calculated Ground water Flow (gallons per day)	ITPH-Pumped Flow (gallons)
5/13/93	0.44	7.55	3,695 gallons	5,200 gallons
5/26/93	0.21	6.45	3,142 gallons	5,300 gallons
7/14/93	-1.24	3.54	1,801 gallons	3,000 gallons
10/11/93	5.95	0.20	1,440 gallons	3,700 gallons
11/1/93	6.0	1.40'	2,255 gallons	7,300 gallons

[a/] ITPH=Interceptor Trench Pump House
[b/] ? = Data unavailable

This further indicates that the ITS is effective in collecting ground water where it is keyed into bedrock. The volume difference between calculated and pumped flows could be accounted for in flows from sources other than upgradient sources. For example, the ITS may be capturing ground water from North Walnut Creek or, the ITS may be collecting ground water from unconsolidated materials in areas where the ITS is not keyed into bedrock.

In summary, the data generated from these strings of piezometers generally support the finding that the ITS is effective in the collection of ground water where the ITS is keyed into bedrock.

A.4.5 ITS Flow Measurements

Accurate long-term ITS flow records were not maintained until April 1993, when ITS inflow was transferred to the TMSTs rather than to the SEPs. The original ITS was constructed without a flow meter, and a paddle-wheel flow meter installed in 1988 produced unreliable readings due to system cavitation. Therefore, the quantity of surface water and ground water collected and transferred from the ITS to the SEPs was never accurately measured. Estimates of the actual transferred quantities were calculated by three separate methods in the ASI study (ASI, 1991) from the limited data available at the time. These methods, and the results, are identified below.

- An approximate water balance around SEP 207B-North, based on West Spray Field pumping records from 1982 through 1985, indicated a total annual collection of 3,043,000 gallons of water by the ITS (ASI, 1991).

- An approximate water balance around SEPs 207B-North, Center, and South, based on depth readings and transfer records from the SEPs from 1988 through 1990, indicated a total annual collection of 3,149,000 gallons of water by the ITS (ASI, 1991).

- Two discrete measurements of inflows to the ITS wet well were made in 1988 and 1990. These two measurements were 4.45 gpm (approximately 2,338,900 gallons per year) and 4.90 gpm (approximately 2,575,400 gallons per year), respectively (ASI, 1991).

The ASI study determined an average of 3,100,000 gallons per year (5.9 gpm) expected to be collected by the ITS (ASI, 1991). A summary of flow estimates reported in the ASI study for discrete portions of the ITS is presented in Table A-9.

TABLE A-9
SUMMARY OF ITPH[a/] SYSTEM FLOW ESTIMATES FOR DISCRETE PORTIONS OF ITPH SYSTEM

Portion of System	Estimated Flow (gpm)[b/]	Percentage of Total ITPH Flow
All	5.9	100
West Collector	1.3	22
E. Extension Inflow	2.0	34
W. Extension Inflow	1.3[c/]	22
E. ITPH Inflow	1.6	27
W. ITPH Inflow	3.6	61

a/ ITPH = Interceptor Trench Pump House.

b/ gpm = gallons per minute.

c/ This is an assumed flow. Only two measurements of flow have been made at this location. These measurements were an order of magnitude different, and therefore, the flow reported for this location is simply the flow recorded at the West Collector. This number should represent a minimum flow at the point of measurement.

NOTE: The eastern and western inflows to the ITPH only account for only 88% of the total flow. One of the reasons for the slight discrepancy between total annual flow and the summation of individual flows is that total flow is based on several data sources covering several years of data. The flow measurements on portions of the system are based on a limited data record with several measurements being made during dry periods. It is determined that the slight discrepancy is due to the different bases for the data.

Source: ASI, 1991, "Solar Pond Interceptor Trench System Ground Water Management Study," Task 7 of the Zero-Offsite Water Discharge Study, Final, Prepared for EG&G Rocky Flats, Inc. Facilities Engineering, January 8, Table A-9 Summary of Interceptor Trench System Pump House System

Since April 1993, inflow collected by the ITS has been transferred to the TMSTs. ITS flow estimates can now be supported by field data because of the addition of a flow meter on the ITS force main in April 1993. Data from this flow meter have been recorded since May 1993. These data represent total quantities of water transferred to the TMSTs. These overall measurements of amounts collected by the ITS can be supplemented with data regarding flows for discrete portions of the ITS. EG&G personnel currently record daily ITS flows in a log maintained at the ITS.

Accurate flow data from the ITS are generally available from May 11, 1993 through January 12, 1994. However, the meter was inoperative from June 5, 1993 until July 12, 1993. Data are also unavailable from August 3, 1993 through September 13, 1993. Thus, some considerable data gaps exist with regard to the total gallons pumped by the system. These data have been recorded as part of the TMST operational activities. Precipitation data are also available for this period, but only through the end of December 1993. The last few weeks of pumping data have no related precipitation data available for correlation.

These flow data indicate that the ITS experiences large fluctuations in the quantities of water collected on any single day. Figure A-7 is a plot of volumes of water pumped by the TMST system compared with daily precipitation volumes. The conclusions that can be drawn from comparison of volumes of water pumped from the ITS to precipitation events are generally predictable given the design of the ITS. These conclusions include:

- The ITS collected 900,100 gallons of water over a 167-day period for which daily flow data are available. Therefore, the average daily collection is 5,390 gallons per day or approximately 3.7 gpm. This average daily flow would account for collection of approximately 1,969,000 gallons per year of ITS water. This annual volume is less than that predicted in the 1991 ASI study, which stated that the ITS should collect 3,100,000 gallons of water in a typical year (5.9 gpm). This difference in the actual volume collected compared with the predicted volume is partly explained by the current ITS data record not including some of the wet spring months when significant quantities of flow were probably collected by the ITS. Similarly, for the period May through December 1993, the amount of precipitation that fell at RFP was 72 percent of normal. Thus, the ITS would be expected to collect less water during 1993 than in a more typical year. Another factor that accounts for smaller quantities of water collected by the ITS than predicted is the fact that the West Collector no longer contributes flows to the ITS. It was estimated that the West Collector accounted for 22 percent of the ITS flow in the ASI study (ASI, 1991).

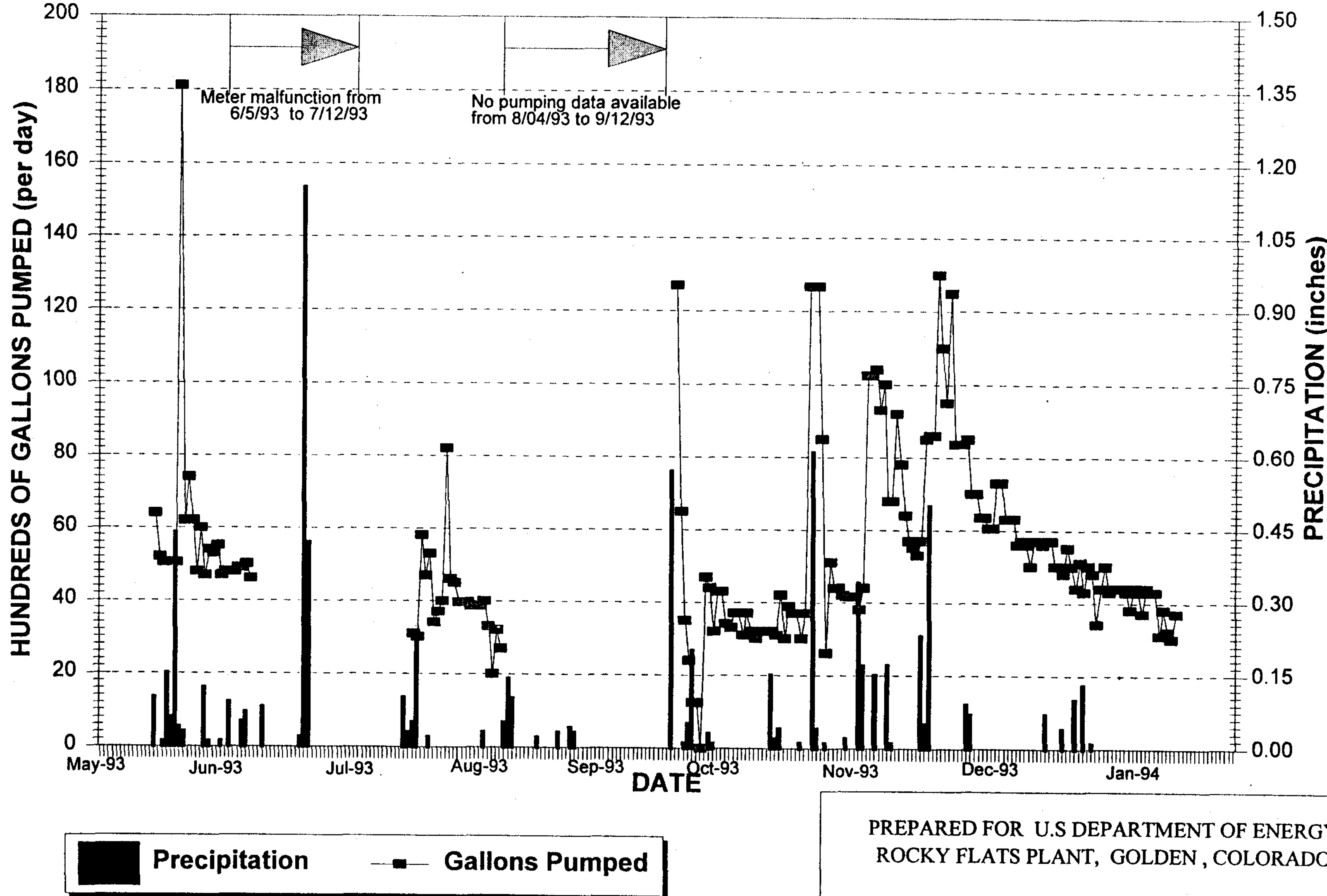

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Figure A-7
ITS PUMPING AND PRECIPITATION RECORD

- The maximum volume of water collected on any one day during the period of record is 18,100 gallons on May 18, 1993, or approximately 13 gpm. This volume of water was collected following a 0.44-inch storm event. The majority of the 18,100-gallon flow is assumed to be storm water collected by the ITS.

- The volume of water typically collected by the ITS in a single day varies from 2,000 to 5,000 gallons (1.4 gpm to 4.9 gpm).

- The ITS pumping rate increased immediately in response to 0.44-inch precipitation event of May 17, 1993. This response is attributed to the collection of storm water by the Southern Extension of the ITS.

- During the May through December 1993 period, only eight precipitation events (May 17, June 17, June 18, September 7, September 13, October 17, October 28, and November 14) exceeded 0.25 inches of precipitation. Three of these eight storm events occurred when no data from the flow meter are available for correlation (June 17, June 18, and September 7). The first two of these three undocumented periods were due to mechanical malfunction of the meter, while for September 7, no data from the flow meter are currently available. The volume of ITS water pumped on the day of and immediately following the other precipitation events (on May 17, September 13, October 17, October 28, and November 14) indicate that a considerable amount of storm water was collected by the ITS.

- Although data are limited, it appears that storm events of less than 0.25 inches result in little or no storm water collection by the ITS. Large surges in ITS flow are not noted following isolated storms of less than 0.25 inches. Large increases in flow are noted when smaller storm events follow larger storm events, but these flow increases are thought to be mainly due to the larger storm event.

- The ITS sometimes has a delayed response to precipitation events. This response, indicated by an increase in the pumped flows, is attributed to the collection of increased quantities of ground water by the ITS. An increase in the quantities of ground water available for collection is expected following storm events due to infiltration of precipitation and recharge of the ground water table.

Section 3.4 of this report presents a brief comparison of the quantities of ground water that should be collected by the ITS to actual ITS pumped volumes. In all cases, the ITS pumped more water than required to account for maximized estimates of ground water flow.

A.4.6 Water Chemistry

Characterization of ITS water chemistry is based on analyses of surface water and ground water samples from discrete portions of the ITS drain system (ASI, 1991) and hydrologic and water-quality studies of the SEP area. Water quality analyses indicate the presence of nitrate, radionuclides, and VOCs in both surface water and ground water.

The quality of water flowing into the ITS is expected to vary significantly by collector area. The general SEP area and nearby ground water and seepage flows typically contain elevated concentrations of nitrates and radionuclides. For instance, VOCs predominated in flows from the West Collector area, and this area may have contributed up to one-half of the total VOCs present in the ITS (ASI, 1991). However, as discussed in Section 2.1 of this report, the flows from the West Collector area are not being effectively captured by the ITS at the current time. Based on this information, it is predicted that recent data for VOCs in water collected by the ITS will exhibit considerably reduced VOC concentrations when compared to data generated prior to 1992. Similarly, the surface runoff from the Building 779 area is presumed to be relatively clean. This runoff significantly increases the total volume of flow to the ITS, and thereby impacts the overall quality of the ITS outflow to the TMSTs (EG&G, 1993a). Should the Building 779 area runoff be segregated from the ITS, then the concentrations of contaminants noted in the ITS water may increase due to significantly decreased dilution.

In general, contaminated ground water plumes in the unconsolidated materials downgradient of the SEPs appear to be effectively collected by the ITS. The exception to this general statement is the area northeast of the 207B Series SEPs. In this area, a nitrate-contaminated ground water plume is believed to exist (EG&G, 1993b), and appears to be migrating past the ITS. In this location, the ITS is generally constructed above the top of bedrock elevation. Therefore, in this area the ITS cannot collect all ground water flows, and is recommended for upgrading.

A.5 SUMMARY OF ITS EFFECTIVENESS

Data currently available indicate that where the ITS is keyed into bedrock, it is effective in collecting ground water flows. The ITS was built to intercept approximately 1,760 feet of ground water flow in unconsolidated materials perpendicular to the ground water flow path, but is apparently capable of desaturating 1,400 feet. The farthest east 228 feet of the ITS are not keyed into bedrock and therefore cannot completely desaturate the unconsolidated materials. Thus, the ITS can only be effective in desaturating the unconsolidated materials over approximately 80 percent of its design area. Although the evaluation conducted is adequate to determine whether or not major portions of the ITS are not functioning, the field data used to evaluate the ITS was not of sufficient detail to ensure that all areas of the ITS are without problems (such as crushed or plugged pipes). Further observations regarding the ITS are identified below.

- The limiting hydraulic component of the ITS is the 4-inch-diameter PVC pipe connecting the ITS Southern Extension to Pipe 12 of the original ITS. This pipe will convey approximately 67 gpm of water when flowing full and when water at its inlet is backed up to the inverts of the incoming pipes on the Southern Extension manhole.

- Field observations of the West Collector from the fall of 1992 to the present have identified no flow through the West Collector into the western pipe of the ITS Southern Extension. There no longer appears to be a hydraulic connection between the West Collector and the Building 774 pond. Earlier studies had estimated that the West Collector accounted for approximately 22 percent of total flows collected by the ITS (ASI, 1991).

- The ITS appears to desaturate the unconsolidated materials where it is keyed into bedrock. Piezometers completed in the unconsolidated materials immediately upgradient and downgradient of the ITS (piezometer strings PZ01 and PZ04) have generated data consistent with this statement. Other reports have documented the extent of these desaturated unconsolidated materials (see Figures 4-34 and 4-35 in the "Final Ground Water Assessment Plan" [EG&G, 1993b]).

- The Southern Extension of the ITS will collect storm water flows in addition to ground water flows. Storm water concepts and modeling predict that precipitation events exceeding the 0.25 inch/2-hour storm event will generate storm water runoff which will be collected by the ITS Southern Extension.

- Storm water concepts and modeling predict that storm water collected by the ITS from the Building 779 area alone can account for approximately 36 percent (approximately 700,000 gallons) of total average annual ITS flows.

- The flow record from the ITS is not sufficient at this time to verify at what point storm water collection by the ITS becomes significant. A 0.44-inch storm event on May 17, 1993, for example, produced considerable storm water collected by the ITS the day of the storm event and the following day. The data indicate that storm water collected on those two days was on the order of 14,000 gallons the first day and 11,900 gallons the second day, assuming a base flow of approximately 6,200 gallons per day in that period.

- When significant quantities of storm water are collected, the ability of the ITS to convey those flows to the ITS pump house may be insufficient for the total flows collected in the ITS Southern Extension. In such an instance, water may back up into the ITS Southern Extension pipes and may exfiltrate into the surrounding soils and bypass the ITS Southern Extension collection pipe.

- The design of the ITS is such that additional pipes downgradient of the Southern Extension are capable of re-capturing and conveying ground water flows that have bypassed the ITS Southern Extension collection pipes.

- Although the daily flow record from the ITS pump house is limited, the average daily flow from a period of 167 days extended over a one-year period indicates that the ITS should collect approximately 1,969,000 gallons in that year. Precipitation records over the period in which this flow data were generated indicate that the amount of precipitation recorded was 72 percent of normal.

- Expected flows within the ITS have been calculated based on complete capture of all ground water in areas where the ITS is keyed into bedrock. These expected flows were maximized by using maximized thicknesses of saturated unconsolidated materials. These calculations were made during periods in which a precipitation event had not occurred for some time, thus ensuring that the ITS was not collecting storm water runoff. The calculated flows for the ITS are less than the actual flows recorded in the ITS during these periods. This indicates that the ITS is collecting other flows (such as from the North Walnut Creek area) that have not been accounted for in this evaluation.

- In general, in areas in which contaminated ground water plumes occur in the unconsolidated materials downgradient of the SEPs, the contaminated ground water is effectively collected by the ITS.

- Notably, the area northeast of the 207B Series SEPs appears to have a nitrate-contaminated ground water plume in the unconsolidated materials that is not collected by the ITS (EG&G, 1993b). In this area, the ITS is generally constructed above the top of bedrock elevation. Therefore, it cannot collect all ground water in the unconsolidated materials. This area of the ITS may require upgrading.

- Similarly, the existence of a paleochannel trending to the northeast away from the SEPs is indicated by data from piezometer string PZ03. Piezometer 44893 appears to have been installed in this paleochannel. Available data indicate that the bottom of this paleochannel passes beneath the ITS system collection pipes in the area of piezometer string PZ03. The ground water present in piezometer 44893 is indicative of the ineffectiveness of the ITS system in collecting ground water in this paleochannel. Additional characterization of this paleochannel is recommended in the Phase II Field Sampling Plan (5.0 of this report).

REFERENCES

ASI. 1991. *Solar Pond Interceptor Trench System Ground Water Management Study*, Task 7 of the Zero-Offsite Water Discharge Study, Final, Prepared for EG&G Rocky Flats, Inc., Facilities Engineering. January 8.

EG&G. 1991. 1990 Annual RCRA Ground Water Monitoring Report for Regulated Units at Rocky Flats Plant. EG&G, Rocky Flats Plant, Golden, Colorado.

EG&G. 1993a. *Interceptor Trench System Water Balance*, EG&G Internal Report, Submitted to the SEPs Project Office, by the Surface Water Division. April 13.

EG&G. 1993b. *Final Ground water Assessment Plan*, Environmental Management Department. February.

Wright Water Engineers. 1992. *Rocky Flats Plant Drainage and Flood Control Master Plan*, Prepared for EG&G Rocky Flats. April.

APPENDIX B

APPENDIX B

BUILDING 774 (BOWMAN'S POND) NARRATIVE

TABLE OF CONTENTS

LIST OF TABLES

BUILDING 774 (BOWMAN'S) POND NARRATIVE

B.1. Brief History of Building 774 Pond and Its Relationship to the Solar Evaporation Ponds

The Building 774 Pond at the Rocky Flats Plant (RFP) is located north of Building 774, east of Building 770, and west of two condensate holding tanks. The pond is also referred to as Bowman's Pond, the Building 774 Pond, the Building 774 footing drain collection area, and the Building 771/774 footing drain collection area. For this discussion, this pond will be referred to as the Building 774 Pond (or, the pond). The pond is approximately 15 feet by 20 feet in size. Immediately west of the Building 774 Pond is a small, inactive pump station previously referred to as the West Collector for the Interceptor Trench System (ITS).

The Building 774 Pond was originally constructed in the early 1970s to allow for the detention and separate management of contaminated flows identified in this area. The exact date of construction is not known, but was sometime between March 1971 and May 1974. In March 1971, the Building 774 footing drains were identified as a potential problem area due to elevated radiological activity measurements associated with the footing drain water. Activity measurements in the region of 500 disintegrations per minute per liter (dpm/L) were reported. At that time, the area in which the footing drains surfaced had been buried under three feet of soil (Lee, 1971). In May 1974, the Building 774 Pond was to be enlarged to a size sufficient for containment of the normal flow for a minimum of three days (Owen, 1974). Water collected in the pond was to be handled in one of two ways. If the tritium concentration of the water was less than 50,000 picocuries per liter (pCi/L), the water was to be sprinkled on the area north and west of the RFP landfill. If the tritium concentration of the water exceeded 50,000 pCi/L, the water was to be transferred to Solar Evaporation Pond 207B-South (Owen, 1974). Management of this water changed in March 1975, when changes were made to North and South Walnut Creeks that allowed for the isolation of drainage Ponds B-2 and A-2 from normal stream flows, so that these ponds operated in a zero-discharge manner for treated process waste discharges. The water was now to be trucked to Drainage Pond B-2 for impoundment (Thompson, 1975).

A submersible pump was later installed in a pump station adjacent to the pond to better control contaminated water by pumping it to SEP 207C. Although final as-built drawings were not located for this control structure, Rockwell International Drawings 29147-1 and 29147-2 (Rockwell, 1975) describe a similar pumping system that was designed in 1975. The existing system is similar to the designed system, but a number of differences exist (ASI, 1991). This pump station operated until approximately 1981 when it was connected to the ITS as a portion of the Protected Area (PA) improvements (Maas, 1990). This connection, which was made at the far western end of the Southern Extension, allowed the Building 774 Pond pump station to drain by gravity into the ITS. Water that collected in the ITS drained by gravity to the pump house near North Walnut Creek. The ITS pump house routed collected water to SEP 207B-North.

Until the fall of 1992, water from the Building 774 Pond contributed a portion of the western flow to the ITS, which pumped water back to SEP 207B North (ASI, 1991). No accurate long-term flow records are available because no flow meter was ever installed on the ITS or the West Collector. Occasional observation of the unit from 1988 to 1990 indicated that the system was fairly stable without large fluctuations in flow. On September 7 and 17, 1990, flow from the pond to the ITS was estimated to average 1.3 gallons per minute (gpm). At that time, the pond/West Collector may have accounted for as much as 683,000 gallons per year, or 20 percent, of the total flow pumped back to the SEPs (ASI, 1991). In the fall of 1992, visual inspection of the system indicated that the flows from the Building 774 Pond were no longer being drained by the ITS or the West Collector. By late spring of 1993, the pond was overtopping its berm; however, the exact reason for the hydraulic isolation of the Building 774 Pond from the West Collector is not known.

B.2 Sources of Flows into the Building 774 Pond

Based on review of engineering drawings, site walks, interviews with long-time RFP personnel, and review of other written documents, the Building 774 Pond appears to collect water associated with footing drain flows from Building 774, possibly Building 771 footing drain flows, and stormwater. Some of the Building 771 footing drains are believed to have been re-routed during PA construction activities to drain into the Building 774 Pond (according to interviewees), but engineering drawings have not been found to support this belief. The Building 771 and 774 footing drain systems are discussed in more detail below because they are likely pathways of contaminant transport to the Building 774 Pond.

Building 774 Footing Drains

With regard to flows from the Building 774 footing drains, five outfalls were identified in "A Description of Rocky Flats Foundation Drains" (EG&G, 1992) in the general area of the Building 774 Pond. Three footing drains are known to be associated with these five outfalls. The original drain system for the building consists of a foundation drain identified on Drawing 25581-6, but not shown on 1980 or 1990 Site Utility Drawings (EG&G, 1992). Three foundation drains are clearly shown on 1990 Site Utility Drawing 15501-13 (DOE, 1990) and were likely installed as part of post-1975 additions to Building 774 (EG&G, 1992). For consistency, these outfalls will be discussed in order from west to east according to outfall numbers designated in the EG&G report. All of these outfalls are believed to flow in the direction of the ITS (EG&G, 1992); however, only outfalls 1 through 3 could flow into the Building 774 Pond area west of the condensate tanks.

Outfall 1 is actually a storm sewer outfall from a metal culvert located immediately east of Building 770 (Hoffman, 1983; Moody, 1977). The culvert is not shown on 1990 engineering drawings. This outfall may have been confused with footing drain 774-1 (Outfall 2), during all or some of sampling activities prior to 1993 (EG&G, 1992). Flow estimates made on April 15, 1993, during a period of high ground water levels, indicated that 1 to 2 gpm were draining from this outfall. It is unknown whether the source of the water is from a footing drain, general ground water seepage, or a leaking water line (EG&G, 1993a). Flow from this outfall enters the Building 774 Pond.

Outfall 2, located east of Building 770, is believed to represent the outfall for the foundation drain identified on Engineering Drawing 25581-6. This outfall emerges from an 18" corrugated metal pipe that carries flows from an 8" footing drain on the southern side of Building 774 and from two catch basins north of the Building 771/774 tunnel, based on Drawing 15501-12 (DOE, 1990). However, the possibility exists that flow from the 4" foundation drain located on the northern side of Building 774 also flows through this 18" cmp (DOE 1990; EG&G 1993a). This outfall is denoted as FD-774-1 and is designated as a footing drain sampling location (Hoffman, 1983; EG&G, 1992). On April 15, 1993, flows from this drain during a period of high ground water levels were 0.5 to 1 gpm (EG&G, 1993a). This location is currently designated by the EG&G Surface Water Division (SWD) as SW084 (EG&G, 1992) and is routinely sampled by SWD. Flow from this outfall enters the Building 774 Pond.

Outfall 3 is believed to be the outfall for the 4" footing drain north of Building 774 and southwest of the condensate tanks (DOE, 1990; EG&G, 1992). Based on discussions with building personnel, this drain was unintentionally cut and blocked during expansion of a Building 774 loading dock in 1987 and 1988 (EG&G, 1992). Shortly thereafter, the basement of Building 774 exhibited seepage of water through the floors and walls. In response, a small sump was constructed in the floor of the building to allow for sampling and management of the seepage, which is now pumped to the process waste tanks (EG&G, 1992). Interviews with RFP personnel revealed that this water was elevated in gross alpha activity. No flows from the outfall were observed during recent inspections. It is unknown whether or not this drain is completely blocked (EG&G, 1992). Any flows from this outfall would enter the Building 774 Pond.

Two other outfalls discharge to the east of the condensate tanks. Flow from these outfalls would not enter the Building 774 Pond, but could impact the general area of the Building 774 Pond. Outfall 4, which is not depicted on engineering drawings, emerges from a polyvinyl chloride (PVC) pipe near the southeastern corner of the condensate tanks. It is unknown whether this storm drain is tied into a foundation drain or serves another purpose (EG&G, 1992). Outfall 5 is connected to the eastern-most footing drain, which collects water along the southeastern side of the building. Its flows are transported by a 6" cmp to Outfall 5, north of trailer T771G (DOE, 1990; EG&G, 1992). This outfall was dry during 1992 inspections (EG&G, 1992). Engineering Drawing 38544-101 (Rockwell, 1989) indicates that a footing drain manhole exists to the east of Building 774, apparently buried at a depth of approximately 10 feet. In addition, Engineering Drawing 38544-101 indicates the existence of a footing drain clean-out just east of Tank 68. An 8" foundation drain is located on the southern end of Building 774, but no outfall has been located for this drain; it may tie into one of the other foundation drains or pipes in this area (DOE, 1990; EG&G, 1992). Any flows from this latter outfall, if it exists, would not enter the Building 774 Pond.

Based on review of engineering drawings, site-walks, and interviews, it is generally believed that most of the Building 774 footing drains currently drain into the Building 774 Pond area; however, it is unclear which of the pipes draining into the pond are associated with Building 774 footing drain flows. There have been a number of construction projects in the Building 774 area and it is likely that these projects encountered footing drains which were then rerouted or blocked. It is believed that the original footing drains are currently located underneath concrete or building structures and that no known footing drains were added during construction activities. The remaining drains are probably still in place but are not serving their original purpose.

Building 771 Footing Drains

The footing drains from Building 771 originally flowed to the north and west of Building 771 and surfaced in drainage structures that eventually flowed into North Walnut Creek. Originally there were three footing drains associated with Building 771. Two of these three footing drains flowed into a manhole just west of Building 728, and then proceeded to surface further to the northwest of the manhole. Engineering projects in the Building 771 area have modified the area such that stormwater and North Walnut Creek drainage flows to the northwest of Building 771 are now contained within a series of buried culverts. It is believed that the footing drains that flowed to the northwest from the manhole west of Building 728 have been rerouted so that the flows do not enter the drainage culverts in this area. Engineering Drawing 27550-50 indicates that the drain leading to the northwest from the manhole located west of Building 728 has been plugged. An alternate drainage path for the footing drains was not identified on that engineering drawing or on any other engineering drawing identified to date. The exact locations of the discharges of these Building 771 footing drains are unknown at this time. A letter dated February 1971 contained the first known reference to plugging of the pipe that is believed to have carried Building 771 footing drain flows. Although the suggestion had been made to cap the line, the line was not capped at that time because flows from the pipe were not contaminated (Bowman, 1971).

It has been stated by interviewees that the Building 771 footing drains were rerouted to flow to the north and east of Building 771, and possibly to the Building 774 Pond. Again, no engineering drawings supporting this drainage route have been identified. However, two pipes concurrently route water flows into the Building 774 Pond that are not identified on engineering or utility drawings. These pipes could convey Building 771 footing drain flows into this pond. Alternatively, footing drain flows could have been routed into either of the two other known pipes that drain into the Building 774 Pond. Although not conclusive, written records indicate that Building 771 and Building 774 footing drains became related in the early 1970s. There is no direct relation between the original discharge points of the Building 771 and 774 footing drains (the discharge points were approximately 500 feet apart). However, if some or all of the Building 771 footing drains were routed to approximately the same discharge location as the Building 774 footing drains, then a relation between these two sets of footing drains would be established.

The apparent relationship of Building 771 and Building 774 footing drains is evidenced in the following quotes:

- "C.M. Love described sampling results on footing drain water collected in the vicinity of Buildings 771-774. The concentration of tritium in drains near Building 771 on December 11, 1973 was 95,000 pCi/L. On the same date, the comparable result for the drain water near Building 774 was 3,000 pCi/L" (Werkema, 1974).

- "160,000 gallons (70,000 gallons from the landfill and 90,000 gallons from the 771-774 Building footing drain) of ^{3}H-contaminated water were sprinkled north of the landfill. The weighted average concentration was 2.6 x 10^{4} pCi/L" (Thompson, 1974).

In addition to the above statements, a May 1974 letter to the Atomic Energy Commission discusses water from the Building 771 and 774 footing drains as draining into the pond north of Building 774. This letter also indicates that the pond would be enlarged to contain the normal flow for a minimum of three days, and contains a disposition plan for that water. If the water contained less than 50,000 pCi/L of tritium, the water was to be sprinkled in the area to the north and west of the landfill. However, if the water contained more than 50,000 pCi/L of tritium, the water was to be transferred to SEP 207B-South (Owen, 1974). This letter indicates that a piping change must have been made by May 1974 that allowed for at least some of the Building 771 footing drain flows to enter the Building 774 Pond. This change is indicated by the manner in which the letter addresses the Building 771 and the Building 774 footing drains together and by the manner in which the letter indicates that the footing drains from both buildings flowed to the same pond. In contrast, a considerable amount of written documentation from 1971 discusses the Building 774 and Building 771 footing drains as separate and distinct issues. Therefore, an inference could be made that the drains were separate in 1971 and no longer separate (i.e., were plumbed together), in or before 1974.

B.3 Monitoring Data

Water samples taken over a 15-year period demonstrate that the Building 774 Pond has experienced elevated levels of radionuclides, nitrate, aluminum, and other water quality parameters. Selected sample results are discussed below and are presented in Table B-1. Data gaps exist for the years 1972 to 1973, 1975 to 1976, and 1982 to 1987. Analysis of recently generated data (1993) has not been done on a station-by-station, analyte-specific basis.

Current surface water monitoring stations located in the immediate vicinity of the Building 774 Pond include Stations SW084, SW086, SW124, and SED124. Station SW084 samples water from flows into the pond and from water present in the pond. Station SW086 samples the surface water entering the ITS through the West Collector, including water from the SW084 and SW124 area. Station SW124 is an additional surface water monitoring station which samples some of the flows entering the Building 774 Pond upstream of Station SW084, closer to where the flows surface from their pipes.

TABLE B-1
DATA FROM BUILDING 774 POND AREA

DATE	GROSS ALPHA	PLUTONIUM	TRITIUM	GROSS BETA	NITRATE NITROGEN	VOCs[a]
March 1971	500 dpm/L (Lee, 1971)	--[c]	--	--	--	--
May 1971	Evaporator Condensate Discharge: 2.56 dpm/g[b]; Footing Drains: 3.62 dpm/g, 3.46 dpm/g, 1900 dpm/g (Kittinger, 1971)	--	--	--	--	--
May 1971	Evaporator Condensate: 100 dpm/L; Footing Drains: 400 dpm/L plutonium (Freiberg, 1971)	--	--	--	Evaporator Condensate: 5 ppm[e]; Footing Drains: 800 ppm (Freiberg, 1971)	--
May 12, 1971	774 Footing Dain: 12.36 pCi/L[f] (gross alpha); 774 Evaporator Condensate: 4.38 pCi/L (gross alpha), (Chinn, 1970/71)	774 Footing Drain 1.26 pCi/L 774 Evaporator Condensate: 43 pCi/L	--	--		--
January 9, 1974		--	Footing Drains: Building 771: 95,000 pCi/L tritium; Building 774: 3,000 pCi/L tritium (Werkema, 1974)	--		--
June 1974		--	Building 771/774 Footing Drain Water showed weighted average concentration of tritium of 2.6×10^4 pCi/L (90,000 gallons to be sprayed near landfill) (Thompson, 1974)	--		--
1977 - 1981[g]	3 - 42 pCi/L (Hoffman, 1981)	--	(3,368 x 8,395) pCi/L	(21-53) pCi/L	14.8 - 108.5 ppm (Hoffman, 1981)	--

TABLE B-1 (Continued)
DATA FROM BUILDING 774 POND AREA

DATE	GROSS ALPHA	PLUTONIUM	TRITIUM	GROSS BETA	NITRATE NITROGEN	VOCs[a/]
1988 - 1990 (Surface Water Station SW084)	2.87 - 83 pCi/L (ASI, 1991)	--	--	--	5.7 - 23.8 ppm (ASI, 1991)	Acetone 10 - 110 ppb[h/]; carbon tetrachloride 5 - 100 ppb[g/] (ASI, 1991)
1988 - 1990 (Surface Water Station SW086)	0 - 44 pCi/L (ASI, 1991)	--	--	--	8.7 - 18 ppm (ASI, 1991)	Acetone 0 - 11 ppb; carbon tetrachloride 5 - 64 ppb (ASI, 1991)
1992/1993[i/]	Within RFP[j/] Internal Control Guidelines (EG&G, 1993b)	--	--	--	Within RFP Internal Control Guidelines (EG&G, 1993b)	Within RFP Internal Control Guidelines (EG&G, 1993b)

a/ VOCs = volatile organic compounds.
b/ dpm/L = disintegrations per minute per liter.
c/
d/ dpm/g = disintegrations per minute per gram.
e/ ppm = parts per million.
f/ pCi/L = picocuries per liter.
g/ The report also stated that the tritium and nitrate concentrations within the Building 774 Pond were very similar to those noted in the footing drain outfall.
h/ ppb = parts per billion.
i/ Outstanding hits of aluminum, iron, and gross beta were noted in the Building 774 footing drain; other constituents were within RFP internal guidelines.
j/ RFP - Rocky Flats Plant.

In Task 7 of the Zero Discharge Study (ASI, 1991), surface water sampling data from Stations SW084 and SW086, taken from 1988 to 1990, were analyzed. Results showed slightly basic water with elevated volatile organic compounds (VOCs) at Station SW084, including acetone at 110 milligrams per liter (mg/L) maximum concentration and carbon tetrachloride at 100 mg/L maximum concentration. In addition, gross alpha particles ranged from 3 to 83 pCi/L. Surface water samples from Station SW086 were dilute in comparison to those from Station SW084, with the exception of one possibly anomalous americium-241 value.

When the ASI report was prepared, a number of samples had been collected at surface water monitoring stations SW094 and SW095. These surface water monitoring stations represent water quality conditions at the wet-well of the ITS. At that time, available data from Stations SW094 and SW095 indicated the occasional presence of VOCs in the ITS water. Mass loading calculations made as a part of that report indicated that the majority of VOC contamination in ITS water (53 percent) was from the water collected by the West Collector of the ITS, even though the West Collector only accounted for 22 percent of the overall flows recorded by the ITS (ASI, 1991). A former carbon tetrachloride tank that had been located in the area could have caused the VOC contamination in water samples from the Building 774 Pond area. It should be noted, though, that the quality assurance and quality control measures on samples collected prior to 1991 are seriously questioned, and much of the pre-1991 data are considered unreliable. The West Collector is not currently contributing flow to the ITS. Assuming that older samples indicating VOC contamination in the Building 774 Pond area were accurate, the VOC contamination of the ITS system should be less than reported by ASI. The flows collected by the ITS should also be less than reported by ASI since the 1991 report stated that the West Collector accounted for 22 percent of the total ITS flow.

More recent results from 1993 footing drain sampling activities showed elevated detections of aluminum, iron, and gross beta at FD 774-1 (Station SW084) (EG&G, 1993b). Sampling and evaluation of footing drains at the plant site are still underway.

B.4 Potential Contaminant Sources

A variety of potential contaminant sources could affect the area near the Building 774 Pond. The footing drains for Buildings 771 and 774 are important pathways for the transport of contaminants to the Building 774 Pond. A spill or release occurring at a considerable distance from the Building 774 Pond could be conveyed to the pond if ground water contaminated by the spill or release is collected by the footing drains of either Building 771 or 774. Although locations of the exact discharge points for all of the Building 771 footing drains are still uncertain, the following text will address the issue as if the Building 771 footing drain were discharging to the Building 774 Pond. Potential contaminant sources of particular note to the Building 774 Pond are briefly discussed below.

- Six underground process waste storage tanks south of Building 774, in use since the late 1950s, were removed in 1972. The physical failure of these process waste storage tanks was a major contributor to soil contamination around Building 774 (Owen and Steward, 1974). It is suspected that minor leakage from these tanks has seeped to the building footing drain tiles, which subsequently drain to the Building 774 Pond area. A more complete discussion of these six process waste tanks and associated releases can be found in the "Historical Release Report" as sites 700-146.1 through 700-146.2 (DOE, 1992).

- Three concrete underground storage tanks used for Building 774 operations are still in existence on the eastern side of Building 774. These tanks have been used for the process waste treatment and storage operations in Building 774. At least one release from these tanks has been documented, and additional releases or related leakage could also be associated with these tanks. Residual contamination present in soils near these tanks could be impacting ground water, and this ground water could be conveyed in footing drains for discharge to the Building 774 Pond. Additional information on these three tanks can be found in the "Historical Release Report" as sites 700-124.1 through 700-124.3 (DOE, 1992).

- An underground carbon tetrachloride tank (which has been removed) south of Building 771 is known to have released carbon tetrachloride to the environment in a number of different events. In particular, this tank is reported to have "failed" in 1981 (Hornbacher, 1981). Contamination from releases associated with this tank could be impacting ground water in the area near the former location of this tank. This ground water could, in turn, be serving as a source of contamination for the footing drains associated with Building 771 or possibly Building 774. A more complete discussion of the use and releases associated with this carbon tetrachloride tank can be found in the "Historical Release Report" as site 700-118.1 (DOE, 1992).

- Under-building contamination may be associated with Buildings 771 and 774, and could be impacting the ground water. Contaminated ground water could be conveyed by the footing drains to the Building 774 Pond where it is discharged to surface water. Evidence of some under-building contamination is found in existing records. For example, in an incident in October 1975, water from beneath the floor of Room 102 of Building 774 was found to have 1,400,000 dpm/L of activity (Johnson, 1975). Alpha activity is assumed, but is not certain. Furthermore, Building 774 has had an organic, oil, and solvent treatment system in operation since the mid-1960s. The storage and treatment of organics by this system could have resulted in leaks and spills that impacted soils under the building, which could be a cause of contamination at the footing drain outfalls. Characterization of under-building contamination will be included in future environmental activities at the RFP. Additional information on the potential existence of under-building contamination can be found in the "Under-Building Contamination" section of the "Historical Release Report" (DOE, 1992).

- On July 21, 1980, an eight-year-old process waste line was discovered to be leaking southeast of Building 774. Process wastewater was observed seeping up in the soil on the southern side of the road southeast of Building 774. The leaking process wastewater flowed downslope and through a 30-foot culvert, along the eastern chain-link fence and under the fence at the corner. From this point, the liquid flowed under the unpaved access road into a boggy area north of Building 774. The vegetation in the boggy area was damaged where the spilled liquid formed a pool. It was estimated that approximately 1,000 gallons had leaked from the process waste line. Analysis of the spilled water indicated 2,500 pCi/L total alpha activity, 4,000 pCi/L gross beta activity, 10,000 mg/L nitrate, and a pH of 12. Residual contamination from this event could be present in soils of the area and could possibly still be impacting ground water. Contaminated ground water could in turn be conveyed in the Building 774 footing drains to the Building 774 Pond. A more complete discussion of the release described above can be found in the "Historical Release Report" as site 700-149 (DOE, 1992).

- Two steel 8,000-gallon aboveground condensate receiving tanks are located immediately southeast of the Building 771/774 footing drain outfall. The two tanks are located on a concrete slab and have badly corroded bottoms. Historically, the tanks held "clean" condensate from an evaporative waste concentration system once used in Building 774. The condensate was tested for radioactive contamination and then released into a swampy area below the tanks. The release from these tanks was not to the Building 774 Pond, but rather to the area immediately adjacent to the Building 774 Pond. The tanks have been out of service as condensate receiving tanks since approximately 1980. The western condensate tank currently receives overflow and precipitation runoff from the bermed area surrounding the sodium hydroxide tank north of Building 774. On June 22, 1987 and again sometime in 1988, the sodium hydroxide tank north of Building 774 was overfilled. In the June 1987 incident, approximately 100 gallons of liquid caustic soda overflowed and ultimately drained to the western condensate receiving tank. Residual contamination could be present in the area of the Building 774 Pond from both the operations of the tanks for condensate materials and from caustic materials associated with the sodium hydroxide tank. A more complete discussion of the sodium hydroxide tank north of Building 774 and its relationship to the condensate receiving tanks can be found in the "Historical Release Report" as site 700-139 (DOE, 1992).

- The storm drains that discharge to the Building 774 Pond area may carry contaminants. In particular, the storm drains are suspected of being the migration route for polychlorinated biphenyls (PCBs) from transformer spills. In the summer of 1991, PCBs were identified in the vicinity of the pond. The source is believed to be Potential Area of Concern (PAC) 700-1112 as defined in the "Historical Release Report (DOE, 1992). Additional information on PCB sampling activities and related releases can be found in the "Historical Release Report" (DOE, 1992).

In addition to the above releases, there are additional releases in the Building 771 and 774 area that could impact the footing drains that discharge to the Building 774 Pond. These releases are identified and discussed in the "700 Area" section of the "Historical Release Report" (DOE, 1992).

B.5 References

ASI. 1991. *Solar Pond Interceptor Trench System Ground water Management Study, Rocky Flats Plant,* Task 7 of the Zero-Offsite Water-Discharge Study, Final. January 8.

Bowman, H.E. 1971. *Drain Pipe in Front of Building 771.* Dow Chemical Company Internal Memorandum to C.W. Piltingsrud. February 19.

Chinn, S. 1971. *Site Survey Soil Sampling Notebooks* 1970 & 1971.

DOE. 1990. *Rocky Flats Plant Site Utility Plan, Engineering Drawing Number 15501-13*, July 20, 1990.

DOE. 1992. *Historical Release Report*, U.S. Department of Energy. June.

EG&G. 1992. *A Description of Rocky Flats Foundation Drains*, EG&G Internal Surface Water Division Report, Report SWD-012-92. November 2.

EG&G. 1993a. *A Description of Rocky Flats Foundation Drains, Updates*, EG&G Internal Surface Water Division Report. June.

EG&G. 1993b. *Results from the Periodic Sampling of Building Sumps and Foundation Drains at Rocky Flats Plant, Outstanding Hits, (1992, 1993)*, EG&G Internal Work-In Progress. 1994.

Freiberg, K.J. 1971. *Health Physics Monthly Status Report - Operations Group Technical And Construction - April, 1971,* Dow Chemical Company Internal Memorandum to E.A. Putzier. May 10.

Hoffman, N.D. 1981. *Water Quality Data for Foundation Drains and Building Sumps from 1977 Through 1981 (Draft)*, Rockwell International Internal Report. December 17.

Hoffman, N.D. 1983. *Locations of Foundation Drains and Building Sumps-Update.* Rockwell International Internal Memorandum to Distribution. October 4, 1983.

Hornbacher, D.D. 1981. *Environmental Analysis Weekly Highlights, Week Ending June 19, 1981,* Rockwell International Internal Memorandum. June 19.

Johnson, C.R. 1975. *Log Book.* October 30.

Kittinger, W.D. 1971. *Items for Further Definition,* Dow Chemical Company Internal Memorandum to C.W. Piltingsrud. May 17.

Lee, W.H. 1971. *Program for Identification of Potential Problem Areas on the Rocky Flats Plant Site with Respect to Radioactive Contamination Outside of Buildings,* Dow Chemical Company Letter to F.E. Abbott of the Atomic Energy Commission. March 15.

Maas, M.E. 1990. Personal Interview with M.E. Maas, Retired Rocky Flats Plant Employee.

Moody, N.E. 1977. *Location of Foundation Drains and Building Sumps,* Rockwell International Internal Memorandum to M.V. Werkema. May 19.

Owen, J.B. 1974. *Water From Footing Drains, Buildings 771 and 774,* Dow Chemical Company Letter to E.W. Bean of the Atomic Energy Commission. May 9.

Owen, J.B. and L.M. Steward. 1974. *Environmental Inventory, a Historical Summation of Environmental Incidents Affecting Soils at or Near USAEC Rocky Flats Plant.* Draft. January 29, 1974. (Date is handwritten on the report and is assumed to be correct.)

Rockwell International. 1975. *Pond Transfer System Pump Assembly,* Engineering Design Drawings, Drawings 29147-1 and 29147-2. April 10.

Rockwell International. 1989. *Rocky Flats Plant, Site Utility Plan, Engineering Drawing 38544-101.*

Thompson, M.A. 1974. *Progress Report for June 1974 Environmental Sciences and Waste Control,* Dow Chemical Company Internal Memorandum to H.E. Bowman. July 12.

Thompson, M.A. 1975. *Progress Report for March 1975 Environmental Sciences and Waste Control,* Dow Chemical Company Internal Memorandum to H.E. Bowman. April 10.

Werkema, G.J. 1974. *Rocky Flats Division Ecology Council Minutes of Meeting Held January 2, 1974 and January 8, 1974,* Dow Chemical Company Internal Memorandum to Distribution. January 9.

APPENDIX C

PRELIMINARY SITEWIDE

CHEMICAL-SPECIFIC

BENCHMARK TABLES

APPENDIX C

PRELIMINARY SITEWIDE CHEMICAL-SPECIFIC BENCHMARK TABLES

The sitewide benchmark tables were created to assist RFP project managers, technical staff, and regulatory oversight personnel in planning and preparing for documented remediation activities. The tables provide a guide when considering benchmarks (standards and criteria). Tables C-1 through C-5 identify preliminary potential chemical-specific benchmarks for ground water, surface water, air, and soil. The tables were designed for sitewide application in accordance with the IAG (IAG, 1992). ARARs specific for OU4 will continue to be identified and further defined throughout the CERCLA process.

The benchmark tables are current as of January 25, 1994, and reflect the existing final regulations on that date. It is recommended that, prior to using the tables as part of the ARAR identification process for OU4, they be verified to determine the current status of individual chemicals, as there are proposed changes to some of the standards and criteria which may become effective in the near future. The benchmark tables do not include proposed standards or criteria.

A detailed discussion of EG&G's approach in using benchmarks can be found in "A Managed Approach to Developing Analytical Programs, Site Characterization, and Regulatory Benchmarks - Draft" (EG&G, 1993).

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Chloride	7647-14-5	A	250,000* (a)					250,000					
Cyanide (Free)	74-90-8	A	200 (h)	200 (h)			200						
Fluoride	10-72-0	A	4,000; 2,000* (a)	4,000 (a)			4,000		2,000				
N as Nitrate		A	10,000 (b)	10,000 (b)			10,000						
N as Nitrate+Nitrite	10-28-6	A	10,000 (b)	10,000 (b)					100,000				
N as Nitrite	7632-00-0	A	1,000 (b)	1,000 (b)			1,000		10,000				
Sulfate	7778-80-5	A	250,000* (a)					250,000					
Sulfide, H2S Undissociated	7783-06-4	A											
Coliform (Fecal)	10-06-0	B	1/100 ml (a)***				1/100 ml						
Ammonia as N	7764-41-7	C											
Dioxin	1746-01-6	D	3.0E-5 (h)	0 (h)		2.20E-07					1.30E-08		
Boron		E							750				
Chlorine, Total Residual	7782-50-5	E											
Sulfur		E											
Dissolved Oxygen	10-88-8	FP											
pH (Standard Units)	10-29-7	FP	6.5-8.5 * (a)					6.5-8.5	6.5-8.5				
Specific Conductance	10-34-4	FP											
Temperature (Degrees Celsius)		FP											
Alkalinity		IN				20,000							
Asbestos		IN	7MF/l (b)	7MF/l (b)									
Total Dissolved Solids (TDS)	10-33-3	IN	500,000* (a)							400,000 (1)			
Total Organic Carbon (TOC)		IN											
Aluminum	7429-90-5	M	50 to 200* (b)						5,000				
Antimony	7440-36-0	M	6 (h)	6 (h)									
Arsenic	7440-38-2	M	50 (a)		50		50		100				
Arsenic III		M											
Arsenic V		M											
Barium	7440-39-3	M	2,000 (e)	2,000 (e)	1,000		1,000						
Beryllium	7440-41-7	M	4 (h)	4 (h)					100				
Cadmium	7440-43-9	M	5 (b)	5 (b)	10		10		10				
Calcium	7440-70-2	M											
Cesium	7440-46-2	M											
Chromium	7440-47-3	M	100 (b)	100 (b)	50		50		100				
Chromium III		M											

022/7246 29/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Chromium VI	7440-47-3	M											
Cobalt	7440-48-4	M							50				
Copper	7440-50-8	M	1,000*/1,300 (f)	1,300 (f)				1,000	200				
Iron	7439-89-6	M	300 * (a)					300	5,000				
Lead	7439-92-1	M	15 (f)	0 (f)	50		50		100				
Lithium	7439-93-2	M							2,500				
Magnesium	7439-95-4	M											
Manganese	7439-96-5	M	50 * (a)					50	200				
Mercury	7439-97-6	M	2 (b)	2 (b)	2		2		10				
Molybdenum	7439-98-7	M											
Nickel	7440-02-0	M	100 (h)	100 (h)					200				
Potassium	7440-09-7	M											
Selenium	7782-49-2	M	50 (b)	50 (b)	10		10		20				
Silver	7440-22-4	M	50 (a)/100*(b)		50		50						
Sodium	7440-23-5	M											
Strontium	7440-24-6	M											
Thallium	7440-28-0	M	2 (h)	0.5 (h)									
Tin	7440-31-5	M											
Titanium	7440-32-6	M											
Tungsten	7440-33-7	M											
Vanadium	7440-62-2	M							100				
Zinc	7440-66-6	M	5,000 * (a)					5,000	2,000				
Aldicarb	116-06-3	P	3 (i)	1 (i)		10							
Aldicarb Sulfone		P	2 (i)	1 (i)									
Aldicarb Sulfoxide		P	4 (i)	1 (i)									
Aldrin	309-00-2	P				0.002					7.40E-05		
Carbofuran	1563-66-2	P	40 (b)	40 (b)		36							
Chloranil	118-75-2	P											
Chlordane	57-74-9	P	2 (b)	0 (b)		0.03					4.60E-04		
Chlorpyrifos	2921-88-2	P											
DDT	50-29-3	P				0.1					2.40E-05		
DDT Metabolite (DDD)	72-54-8	P											
DDT Metabolite (DDE)	72-55-9	P				0.1							
Demeton	8065-48-3	P											
Diazinon	333-41-5	P											
Dieldrin	60-57-1	P				0.002					7.10E-05		
Endosulfan I	959-98-8	P											

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TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Endosulfan II	33213-65-9	P											
Endosulfan sulfate	1031-07-8	P											
Endrin	72-20-8	P	2 (h)	2 (h)	0.2	0.2							
Endrin Aldehyde	7421-93-4	P				0.2							
Endrin Ketone	53494-70-5	P											
Guthion (Azinphos methyl)	86-50-0	P											
Heptachlor	76-44-8	P	0.4 (b)	0 (b)		0.003					2.80E-04		
Heptachlor Epoxide	1024-57-3	P	0.2 (b)	0 (b)		0.09							
Hexachlorocyclohexane, Alpha	319-84-6	P				0.006					0.0092		
Hexachlorocyclohexane, Beta	319-85-7	P									0.0163		
Hexachlorocyclohexane (HCH OR BHC)		P											
Hexachlorocyclohexane, Delta	319-86-8	P											
Hexachlorocyclohexane, Technical (Total)	608-73-1	P									0.0123		
Hexachlorocyclohexane, Gamma (Lindane)	58-89-9	P	0.2 (b)	0.2 (b)	4	0.2					0.0186		
Malathion	121-75-5	P											
Methoxychlor	72-43-5	P	40 (b)	40 (b)	100	40							
Mirex	2385-85-5	P											
Oxamyl (Vydate)	23135-22-0	P	200 (h)	200 (h)									
Parathion	298-00-0	P											
Toxaphene	8001-35-2	P	3 (b)	0 (b)	5	0.03							
Vaponite 2		P											
Aroclor 1016	12674-11-2	PP											
Aroclor 1221	11104-28-2	PP											
Aroclor 1232	11141-16-5	PP											
Aroclor 1242	53469-21-9	PP											
Aroclor 1248	12674-29-6	PP											
Aroclor 1254	11097-69-1	PP											
Aroclor 1260	11096-82-5	PP											
PCBs (Total)	1336-36-3	PP	0.5 (b)	0 (b)		0.005					7.90E-05		
2,4,5-TP Silvex	93-72-1	H	50 (b)	50 (b)	10	50							
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	H	70 (b)	70 (b)	100	70							
Acrolein	107-02-8	H											
Atrazine	1912-24-9	H	3 (b)	3 (b)							3		

022/7246 29/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Bromacil	314-40-9	H											
Dalapon	75-99-0	H	200 (h)	200 (h)									
Dinoseb	88-85-7	H	7 (h)	7 (h)									
Diquat		H	20 (h)	20 (h)									
Endothall	145-73-3	H	100 (h)	100 (h)									
Glyphosate	1071-83-6	H	700 (h)	700 (h)									
Picloram	1918-02-1	H	500 (h)	500 (h)									
Simazine	122-34-9	H	4 (h)	4 (h)							4		
Americium (total)(pCi/l)	7440-35-9	R										0.05	0.05
Americium 241 (pCi/l)	14596-10-2	R											
Cesium 134 (pCi/l)	13967-70-9	R	(7)			80						80	80
Cesium 137 (pCi/l)	10045-97-3	R	(7)										
Gross Alpha (pCi/l)	10-79-7	R	15 (a)(6)				15(6)					7	11
Gross Beta (pCi/l)	10-81-1	R	50 (a)(2)(7)				(7)					5	19
Plutonium (total)(pCi/l)	7440-07-5	R										0.05	0.05
Plutonium 238+239+240 (pCi/l)		R				15						15	15
Radium 226+228 (pCi/l)		R	5 (a)(7)			5						5	5
Strontium 89+90 (pCi/l)	11-10-9	R	(a)(2)(7)										
Strontium 90 (pCi/l)		R	8 (a)(2)(7)			8						8	8
Thorium 230+232 (pCi/l)		R	(a)(7)			60						60	60
Tritium (pCi/l)	10028-17-8	R	20,000 (a)(2)(7)			20,000						500	500
Uranium 233+234 (pCi/l)	11-08-5	R											
Uranium 235 (pCi/l)	15117-96-1	R											
Uranium 238 (pCi/l)	7440-61-1	R											
Uranium (Total) (pCi/l)	7440-61-1	R										5	10
1,2,4,5-Tetrachlorobenzene	95-94-1	SV				2							
1,2,4-Trichlorobenzene	120-82-1	SV	70 (h)	70 (h)									
1,2-Dichlorobenzene (Ortho)	45-50-1	SV	600 (b)	600 (b)		620							
1,2-Diphenylhydrazine	122-66-7	SV				0.05							
1,3-Dichlorobenzene (Meta)	541-73-1	SV				620							
1,4-Dichlorobenzene (Para)	106-46-7	SV	75 (a)	75 (a)		75							
2,4,5-Trichlorophenol	95-95-4	SV											
2,4,6-Trichlorophenol	88-06-2	SV				2					1.2		
2,4-Dichlorophenol	120-83-2	SV				21							
2,4-Dimethylphenol	105-67-9	SV											
2,4-Dinitrophenol	51-28-2	SV				14							

022/7344 29/56.WK1

TABLE C–1 POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site–Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
2,4–Dinitrotoluene	121–14–2	SV											
2,6–Dinitrotoluene	606–20–2	SV											
2–Chloronaphthalene	91–58–7	SV											
2–Chlorophenol	95–57–8	SV											
2–Methylnaphthalene	91–57–6	SV											
2–Methylphenol	95–48–7	SV											
2–Nitroaniline	88–74–4	SV											
2–Nitrophenol	88–75–5	SV											
3,3'–Dichlorobenzidine	91–94–1	SV											
3–Nitroaniline	99–09–2	SV											
4,6–Dinitro–2–methylphenol	534–52–1	SV											
4–Bromophenyl–phenyl–ether	101–55–3	SV											
4–Chloroaniline	106–47–8	SV											
4–Chlorophenyl–phenyl–ether	7005–72–3	SV											
4–Chloro–3–methylphenol	59–50–7	SV											
4–Methylphenol	106–44–5	SV											
4–Nitroaniline	100–01–6	SV											
4–Nitrophenol	100–02–7	SV											
Acenaphthene	88–32–9	SV											
Anthracene	120–12–7	SV											
Benzidine	92–87–5	SV				2.0E–04					1.20E–04		
Benzoic Acid	65–85–0	SV											
Benzo(a)anthracene	56–55–3	SV											
Benzo(a)pyrene	50–32–8	SV	0.2 (h)	0 (h)									
Benzo(b)fluoranthene	205–99–2	SV											
Benzo(g,h,i)perylene	191–24–2	SV											
Benzo(k)fluoranthene	207–08–9	SV											
Benzyl Alcohol	100–51–6	SV											
bis(2–Chloroethoxy)methane	111–91–1	SV											
bis(Chloroethyl)ether	111–44–4	SV				0.03					3.70E–06		
bis(Chloromethyl) ether													
bis(2–Chloroisopropyl)ether	108–60–1	SV											
bis(2–Ethylhexyl)phthalate (Di(2–ethylhexyl)phthalate)	117–81–7	SV	6 (h)	0 (h)									
Butadiene	106–99–0	SV											
Butylbenzylphthalate	85–68–7	SV											
Chlorinated Ethers		SV											
Chlorinated Naphthalenes		SV											

022/7246 29/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)					Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Chloroalkylethers		SV											
Chlorophenol (Total)		SV					1						
Chrysene	218-01-9	SV											
Dibenzofuran	132-64-9	SV											
Dibenz(a,h)anthracene	53-70-3	SV											
Dichlorobenzenes		SV											
Dichlorobenzidine (Total)	91-94-1	SV									0.01		
Diethylphthalate	84-66-2	SV											
Di(2-ethylhexyl)adipate		SV	400 (h)	400 (h)									
Dimethylphthalate	131-11-3	SV											
Di-n-butylphthalate	84-74-2	SV											
Di-n-octylphthalate	117-84-0	SV											
Ethylene Glycol	107-21-1	SV											
Fluoranthene	206-44-0	SV											
Fluorene	86-73-7	SV											
Formaldehyde	500-00-0	SV											
Haloethers		SV											
Hexachlorobenzene	118-74-1	SV	1 (h)	0 (h)		6					7.20E-04		
Hexachlorobutadiene	87-68-3	SV				1					0.45		
Hexachlorocyclopentadiene	77-47-4	SV	50 (h)	50 (h)									
Hexachloroethane	67-72-1	SV									1.9		
Hydrazine	302-01-2	SV											
Indeno(1,2,3-cd)pyrene	193-39-5	SV											
Isophorone	78-59-1	SV				1,050							
Naphthalene	91-20-3	SV											
Nitrobenzene	98-95-3	SV				3.5							
Nitrophenols		SV											
Nitrosamines		SV											
N-Nitrosodibutylamine	924-16-3	SV									0.0064		
N-Nitrosodiethylamine	55-18-5	SV									8.0E-04		
N-Nitrosodimethylamine	62-75-9	SV									0.0014		
N-Nitrosopyrrolidine	930-55-2	SV									0.016		
N-Nitrosodiphenylamine	86-30-6	SV									4.9		
N-Nitroso-di-n-propylamine	621-64-7	SV											
Pentachlorinated Ethanes		SV											
Pentachlorobenzene	608-93-5	SV				6 (6)							
Pentachlorophenol	87-86-5	SV	1 (e)	0 (e)		200							
Phenanthrene	85-01-8	SV											

022/7246 29/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Phenol	108-95-2	SV					1						
Phthalate Esters		SV											
Polynuclear Aromatic Hydrocarbons	10-53-7	SV									0.0028		
Pyrene	129-00-0	SV											
Vinyl Chloride	75-01-4	V	2 (a)	0 (a)		2							
1,1,1-Trichloroethane	71-55-6	V	200 (a)	200 (a)		200							
1,1,2,2-Tetrachloroethane	79-34-5	V									0.17		
1,1,2-Trichloroethane	79-00-5	V	5 (h)	3 (h)		3					0.6		
1,1-Dichloroethane	75-34-3	V											
1,1-Dichloroethene	75-35-4	V	7 (a)	7 (a)		7							
1,2-Dichloroethane	107-06-2	V	5 (a)	0 (a)		0.4							
1,2-Dichloroethene (cis)	156-59-2	V	70 (b)	70 (b)		70							
1,2-Dichloroethene (total)	540-59-0	V											
1,2-Dichloroethene (trans)	156-60-2	V	100 (b)	100 (b)		100							
1,2-Dichloropropane	78-87-5	V	5 (b)	0 (b)		0.56							
1,3-Dichloropropene (cis)	10061-01-5	V											
1,3-Dichloropropene (trans)	10061-02-6	V											
2-Butanone	78-93-3	V											
2-Hexanone	591-78-6	V											
4-Methyl-2-pentanone	108-10-1	V											
Acetone	67-64-1	V											
Acrylonitrile	107-13-1	V									0.058		
Benzene	71-43-2	V	5 (a)	0 (a)		1							
Bromodichloromethane	74-97-2	V	<100** (a)			0.3							
Bromoform	75-25-2	V	<100** (a)			4							
Bromomethane	74-83-9	V											
Carbon Disulfide	75-15-0	V											
Carbon Tetrachloride	56-23-5	V	5 (a)	0 (a)		0.3							
Chlorinated Benzenes		V/SV											
Chlorobenzene	108-90-7	V	100 (b)	100 (b)		100							
Chloroethane	75-00-3	V											
Chloroform	67-66-3	V	<100** (a)			6					0.19		
Chloromethane	74-87-1	V											
Dibromochloromethane	124-48-1	V	<100** (a)			14							
Dichloroethenes		V											
Ethyl Benzene	100-41-4	V	700 (b)	700 (b)		680							
Ethylene Dibromide	106-93-4	V	0.05 (b)	0 (b)									

022/724629/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek
Ethylene Oxide	75-21-8	V											
Halomethanes		V	100 (a)								0.19		
Methylene Chloride	75-09-2	V	5 (h)	0 (h)									
Styrene	100-42-5	V	100 (b)	100 (b)									
Tetrachloroethanes		V											
Tetrachloroethene	127-18-4	V	5 (b)	0 (b)		5					0.8		
Toluene	108-88-3	V	1,000 (b)	1,000 (b)		1,000							
Trichloroethanes		V											
Trichloroethene	79-01-6	V	5 (a)	0 (a)		5							
Vinyl Acetate	108-05-4	V											
Xylenes (total)	1330-20-7	V	10,000 (b)	10,000 (b)									

EXPLANATION OF TABLE AND ENDNOTES
* = secondary maximum contaminant level; TBCs
** = total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
*** = Positive sample no more than once/month (<40 samples/month)

CDH = Colorado Department of Health
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
EPA = Environmental Protection Agency
NCP = National Contingency Plan
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
SW = Solid Waste
TIC = Tentatively Identified Compound
ug/l = micrograms per liter
WQCC = Water Quality Control Commission
MF/l = million fibers/liter

(1) TDS standard - see Table 4 in (d); standard is 400 mg/l or 1.25 times the background level, whichever is least restrictive
(2) If both strontium-90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr
(3) MDL for Radium 226 is 0.5; MDL for radium 228 is 1
(4) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; H=herbicide; IN=inorganic; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile
(5) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be compliance level
(6) Value for gross alpha excludes uranium

022/724629/56.WK1

TABLE C-1 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
GROUNDWATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			FEDERAL STANDARDS			STATE STANDARDS CDH WQCC Groundwater Quality Standards (d)							
						Statewide	Site-Specific (g)						
												Table 6 Radionuclides	
Parameter	CAS No.	Type (4)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goal	RCRA Subpart F Limit (c)	Table A (d) (5)	Table 1 Human Health	Table 2 Secondary Drinking	Table 3 Agriculture	Table 4 TDS	Table 5 Chronic	Woman Creek	Walnut Creek

(7) Average annual concentration of beta particles and photon reactivity cannot exceed 4 millirem/year dose equivalent

(a) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR 141 and 40 CFR 143 (as of 5/19/90)
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective July 30, 1992 (56 Federal Register 3526; 1/30/1991)
(c) NCP, 40 CFR 300; NCP Preamble 55 FR 8764; CERCLA Compliance with Other Laws Manual, EPA/540/G-89/006, August 1988, 40 CFR 264.94
(d) CDH/Water Quality Control Commission, The Basic Standards for Ground Water, 3.11.0 (5 CCR 1002-8) 1/5/1987 effective 11/30/1991; statewide radioactive standards listed in 3.11. 5(C)(2)
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, 143, Final Rule, Effective January 1, 1993 (56 FR 30266; 7/1/1991)
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/91), and 57 FR 28785; (6/29/92) effective 12/7/92; MCLGs effective 11/06/91. Action level in 10% or less of tap samples for small and medium-sized systems.
(g) CDH/Water Quality Control Commission, Classifications and Water Quality Standards for Ground Water, 3.12.0 effective 1/31/94.
(h) EPA National Primary Drinking Water Regulations, 40 CFR 141 and 142, Final Rule, Effective January 17, 1994
(i) EPA National Primary Drinking Water Regulations, 40 CFR 141, Postponement of Final Rule and Reconsideration (57 FR 22178) – no effective date established.

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

							CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Chloride	7647-14-5	A	250,000 *				860,000(g)	230,000(g)		
Cyanide (Free)	74-90-8	A	200 (a)		200 (h)		22	5.2	200	
Flouride	10-72-0	A	4,000; 2,000* (a)		4,000 (a)					
N as Nitrate		A		10,000 (b)		10,000 (b)			10,000	
N as Nitrate+Nitrite	10-28-6	A		10,000 (b)		10,000 (b)				
N as Nitrite	7632-00-0	A		1,000 (b)		1,000 (b)				
Sulfate	7778-80-5	A	250,000* (a)							
Sulfide, H2S Undissociated	7783-06-4	A						2		
Coliform (Fecal)	10-06-0	B	1/100 ml (a)							
Ammonia as N	7764-41-7	C					***			
Dioxin	1746-01-6	D	3.0E-05 (h)		0 (h)		0.01	1.0E-05	1.3E-08	1.4E-08
Boron		E								
Chlorine, Total Residual	7782-50-5	E					19	11		
Sulfur		E								
Dissolved Oxygen	10-88-8	FP					5,000			
pH (Standard Units)	10-29-7	FP	6.5-8.5 * (a)					6.5-9		
Specific Conductance	10-34-4	FP								
Temperature (Degrees Celsius)		FP					SS	SS		
Alkalinity		IN						20,000		
Asbestos		IN		7MF/l (b)		7MF/l (b)				300,000 F/L**
Total Dissolved Solids	10-33-3	IN	500,000* (a)				SS	SS	250,000	
Total Organic Carbon		IN								
Aluminum	7429-90-5	M		50 to 200* (b)			750	87		
Antimony	7440-36-0	M	6 (h)		6 (h)		9,000	1,600	146	45,000
Arsenic	7440-38-2	M	50 (a)						0.0022	0.0175
Arsenic III		M					360	190		
Arsenic V		M					850	48		
Barium	7440-39-3	M	2,000 (e)		2,000 (e)				1,000	
Beryllium	7440-41-7	M	4 (h)		4 (h)		130	5.3	0.0068**	0.117**
Cadmium	7440-43-9	M	10 (a)	5 (b)		5 (b)	3.9 (3)	1.1 (3)	10	
Calcium	7440-70-2	M								
Cesium	7440-46-2	M								

022/724629/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only
Chromium	7440-47-3	M	50 (a)	100 (b)		100 (b)				
Chromium III		M					1,700 (3)	210 (3)	170,000	3,433,000
Chromium VI	7440-47-3	M					16	11	50	
Cobalt	7440-48-4	M								
Copper	7440-50-8	M	1,000 * (a)	1,300 (f)		1,300 (f)	18 (3)	12 (3)		
Iron	7439-89-6	M	300 * (a)					1,000	300	
Lead	7439-92-1	M	50 (a)	15 (f)		0 (f)	82 (3)	3.2 (3)	50	
Lithium	7439-93-2	M								
Magnesium	7439-95-4	M								
Manganese	7439-96-5	M	50 * (a)						50	100
Mercury	7439-97-6	M	2 (a)	2 (b)		2 (b)	2.4	0.012	0.144	0.146
Molybdenum	7439-98-7	M								
Nickel	7440-02-0	M	100 (h)		100 (h)		1,400 (3)	160 (3)	13.4	100
Potassium	7440-09-7	M								
Selenium	7782-49-2	M	10 (a)	50 (b)		50 (b)	20 (d)	5 (d)	10	
Silver	7440-22-4	M	50 (a)	100* (b)			4.1 (3)	0.12	50	
Sodium	7440-23-5	M								
Strontium	7440-24-6	M								
Thallium	7440-28-0	M	2 (h)		0.5 (h)		1,400 (1)	40 (1)	13	48
Tin	7440-31-5	M								
Titanium	7440-32-6	M								
Tungsten	7440-33-7	M								
Vanadium	7440-62-2	M								
Zinc	7440-66-6	M	5,000 * (a)				120 (3)	110 (3)		
Aldicarb	116-06-3	P	3 (i)		1 (i)					
Aldicarb Sulfone		P	2 (i)		1 (i)				10	
Aldicarb Sulfoxide		P	4 (i)		1 (i)				100	
Aldrin	309-00-2	P					3		7.40E-05	7.90E-05
Carbofuran	1563-66-2	P		40 (b)		40 (b)				
Chloranil	118-75-2	P								
Chlordane	57-74-9	P		2 (b)		0 (b)	2.4	0.0043	4.60E-04	4.80E-04
Chlorpyrifos	2921-88-2	P					0.063	0.041		
DDT	50-29-3	P					1.1	0.001	2.40E-05	2.40E-05
DDT metabolite (DDD)	72-54-8	P					0.06			
DDT metabolite (DDE)	72-55-9	P					1,050			
Demeton	8065-48-3	P						0.1		

022/724629/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994) FEDERAL SURFACE WATER QUALITY STANDARDS ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

							CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Diazinon	333-41-5	P								
Dieldrin	60-57-1	P					2.5	0.0019	7.10E-05	7.60E-05
Endosulfan I	959-98-8	P					0.22	0.056	74	159
Endosulfan II	33213-65-9	P								
Endosulfan Sulfate	1031-07-8	P								
Endrin	72-20-8	P	2 (h)		2 (h)		0.18	0.0023	1	
Endrin Aldehyde	7421-93-4	P								
Endrin Ketone	53494-70-5	P								
Guthion (Azinphos methyl)	86-50-0	P						0.01		
Heptachlor	76-44-8	P		0.4 (b)		0 (b)	0.52	0.0038	2.80E-04	2.90E-04
Heptachlor Epoxide	1024-57-3	P		0.2 (b)		0 (b)				
Hexachlorocyclohexane, Alpha	319-84-6	P							0.0092	0.031
Hexachlorocyclohexane, Beta	319-85-7	P							0.0163	0.054
Hexachlorocyclohexane (HCH or BHC)		P					100			
Hexachlorocyclohexane, Delta	319-86-8	P								
Hexachlorocyclohexane, Technical (Total)	608-73-1	P							0.0123	0.0414
Hexachlorocyclohexane, Gamma (Lindane)	58-89-9	P	4 (a)	0.2 (b)		0.2 (b)	2	0.08	0.0186	0.0625
Malathion	121-75-5	P						0.01		
Methoxychlor	72-43-5	P	100 (a)	40 (b)		40 (b)		0.03	100	
Mirex	2385-85-5	P						0.001		
Oxamyl (Vydate)	23135-22-0	P	200 (h)		200 (h)			0.001		
Parathion	298-00-0	P					0.065	0.013		
Toxaphene	8001-35-2	P		3 (b)		0 (b)	0.73	2.0E-04	7.10E-04**	7.30E-04**
Vaponite 2		P								
Aroclor 1016	12674-11-2	PP								
Aroclor 1221	11104-28-2	PP								
Aroclor 1232	11141-16-5	PP								
Aroclor 1242	53469-21-9	PP								
Aroclor 1248	12674-29-6	PP								
Aroclor 1254	11097-69-1	PP								
Aroclor 1260	11096-82-5	PP								
PCBs (Total)	1336-36-3	PP		0.5 (b)		0 (b)	2	0.014	7.90E-05**	7.90E-05**
2,4,5-TP Silvex	93-72-1	H	10 (a)	50 (b)		50 (b)			10	
2,4-Dichlorophenoxyacetic Acid (2,4-D)	94-75-7	H	100 (a)	70 (b)		70 (b)			100	
Acrolein	107-02-8	H					68(1)	21(1)	320	780

022/724629/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

							CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Atrazine	1912-24-9	H		3 (b)		3 (b)				
Bromacil	314-40-9	H								
Dalapon	75-99-0	H	200 (h)		200 (h)					
Dinoseb	88-85-7	H	7 (h)		7 (h)					
Diquat		H	20 (h)		20 (h)					
Endothall	145-73-3	H	100 (h)		100 (h)					
Glyphosate	1071-83-6	H	700 (h)		700 (h)					
Picloram	1918-02-1	H	500 (h)		500 (h)					
Simazine	122-34-9	H	4 (h)		4 (h)					
Americium (total)(pCi/l)	7440-35-9	R								
Americium 241 (pCi/l)	14596-10-2	R								
Cesium 134 (pCi/l)	13967-70-9	R	(4)							
Cesium 137 (pCi/l)	10045-97-3	R	(4)							
Gross Alpha (pCi/l)	10-79-7	R	15 (a)(8)							
Gross Beta (pCi/l)	10-81-1	R	50 (a)(4)(6)							
Plutonium (total)(pCi/l)	7440-07-5	R								
Plutonium 238+239+240 (pCi/l)		R								
Radium 226+228 (pCi/l)		R	5 (a)(4)							
Strontium 89+90 (pCi/l)	11-10-9	R	(a)(4)(6)							
Strontium 90 (pCi/l)		R	8 (a)(6)							
Thorium 230+232 (pCi/l)		R	(a)(4)							
Tritium (pCi/l)	10028-17-8	R	20,000 (a)(4)(6)							
Uranium 233+234 (pCi/l)	11-08-5	R								
Uranium 235 (pCi/l)	15117-96-1	R								
Uranium 238 (pCi/l)	7440-61-1	R								
Uranium (total) (pCi/l)	7440-61-1	R								
1,2,4,5-Tetrachlorobenzene	95-94-1	SV							38	48
1,2,4-Trichlorobenzene	120-82-1	SV	70 (h)		70 (h)					
1,2-Dichlorobenzene (Ortho)	45-50-1	SV		600 (b)		600 (b)				
1,2-Diphenylhydrazine	122-66-7	SV					270 (1)		0.042	0.56
1,3-Dichlorobenzene (Meta)	541-73-1	SV								
1,4-Dichlorobenzene (Para)	106-46-7	SV	75 (a)		75 (a)					
2,4,5-Trichlorophenol	95-95-4	SV							2,600	
2,4,6-Trichlorophenol	88-06-2	SV						970 (1)	1.2 **	3.6 **
2,4-Dichlorophenol	120-83-2	SV					2,020 (1)	365 (1)	3,090	

022/724629/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only
2,4-Dimethylphenol	105-67-9	SV					2,120 (1)			
2,4-Dinitrophenol	51-28-2	SV								
2,4-Dinitrotoluene	121-14-2	SV					330(1)	2?(1)	0.11 **	9.1 **
2,6-Dinitrotoluene	606-20-2	SV					330 (1)	230 (1)	70	14,300
2-Chloronaphthalene	91-58-7	SV								
2-Chlorophenol	95-57-8	SV					4,380 (1)	2,000 (1)		
2-Methylnaphthalene	91-57-6	SV								
2-Methylphenol	95-48-7	SV								
2-Nitroaniline	88-74-4	SV								
2-Nitrophenol	88-75-5	SV					230(1)	150(1)		
3,3'-Dichlorobenzidine	91-94-1	SV							0.01	0.02
3-Nitroaniline	99-09-2	SV								
4,6-Dinitro-2-methylphenol	534-52-1	SV							13.4	765
4-Bromophenyl-phenyl-ether	101-55-3	SV								
4-Chloroaniline	106-47-8	SV								
4-Chlorophenyl-phenyl-ether	7005-72-3	SV								
4-Chloro-3-methylphenol	59-50-7	SV					30 (1)			
4-Methylphenol	106-44-5	SV								
4-Nitroaniline	100-01-6	SV								
4-Nitrophenol	100-02-7	SV					230 (1)	150 (1)		
Acenaphthene	88-32-9	SV					1,700 (1)	520 (1)		
Anthracene	120-12-7	SV								
Benzidine	92-87-5	SV					2,500		1.20E-04	5.30E-04
Benzoic Acid	65-85-0	SV								
Benzo(a)anthracene	56-55-3	SV								
Benzo(a)pyrene	50-32-8	SV	0.2 (h)		0 (h)					
Benzo(b)fluoranthene	205-99-2	SV								
Benzo(g,h,i)perylene	191-24-2	SV								
Benzo(k)fluoranthene	207-08-9	SV								
Benzyl Alcohol	100-51-6	SV								
bis(2-Chloroethoxy)methane	111-91-1	SV								
bis(2-Chloroethyl)ether	111-44-4	SV							0.03**	1.36 **
bis(Chloromethyl)ether		SV							0.00376	0.00184
bis(2-Chloroisopropyl)ether	108-60-1	SV							34.7	4,360
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	117-81-7	SV	6 (h)		0 (h)					
Butadiene	106-99-0	SV								

022/724829/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

							CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Butylbenzylphthalate	85-68-7	SV								
Chlorinated Ethers		SV								
Chlorinated Naphthalenes		SV					1,600 (1)			
Chloroalkylethers		SV					238,000 (1)			
Chlorophenol (Total)		SV								
Chrysene	218-01-9	SV								
Dibenzofuran	132-64-9	SV								
Dibenz(a,h)anthracene	53-70-3	SV								
Dichlorobenzenes		SV					1,120 (1)	763 (1)	400	2,600
Dichlorobenzidine (Total)	91-94-1	SV							0.01	0.02
Diethylphthalate	84-66-2	SV							350,000	1,800,000
Di(2-ethylhexyl)adipate		SV	400 (h)		400 (h)					
Dimethylphthalate	131-11-3	SV							313,000	2,900,000
Di-n-butylphthalate	84-74-2	SV							35,000	154,000
Di-n-octylphthalate	117-84-0	SV								
Ethylene Glycol	107-21-1	SV								
Fluoranthene	206-44-0	SV					3,980 (1)		42	54
Fluorene	86-73-7	SV								
Formaldehyde		SV								
Haloethers		SV					360 (1)	122 (1)		
Hexachlorobenzene	118-74-1	SV	1 (h)		0 (h)				7.2E-04**	7.4E-04**
Hexachlorobutadiene	87-68-3	SV					90 (1)	9.3 (1)	0.45**	50 **
Hexachlorocyclopentadiene	77-47-4	SV	50 (h)		50 (h)		7 (1)	5.2 (1)	206	
Hexachloroethane	67-72-1	SV					980 (1)	540 (1)	1.9	8.74
Hydrazine		SV								
Indeno(1,2,3-cd)pyrene	193-39-5	SV								
Isophorone	78-59-1	SV					117,000 (1)		5,200	520,000
Naphthalene	91-20-3	SV					2,300 (1)	620 (1)		
Nitrobenzene	98-95-3	SV					27,000 (1)		19,800	
Nitrophenols		SV					230 (1)	150 (1)		
Nitrosamines		SV					5,850 (1)			
N-Nitrosodibutylamine	924-16-3	SV							0.0064	0.587
N-Nitrosodiethylamine	55-18-5	SV							8.0E-04	1.24
N-Nitrosodimethylamine	62-75-9	SV							0.0014	16
N-Nitrosopyrrolidine	930-55-2	SV							0.016	91.9
N-Nitrosodiphenylamine	86-30-6	SV							4.9 **	16.1 **
N-Nitroso-di-n-propylamine	621-64-7	SV								

022/724629/57.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c) Acute Value	CWA AWQC for Protection of Aquatic Life (c) Chronic Value	CWA AWQC for Protection of Human Health (c) Water and Fish Ingestion	CWA AWQC for Protection of Human Health (c) Fish Consumption Only
Pentachlorinated Ethanes		SV					7,240 (1)	1,100 (1)		
Pentachlorobenzene	608-93-5	SV							74	85
Pentachlorophenol	87-86-5	SV		1 (e)		0 (e)	20 ***	13 ***	1,010	
Phenanthrene	85-01-8	SV								
Phenol	108-95-2	SV					10,200 (1)	2,560 (1)	3,500	
Phthalate Esters		SV					940 (1)	3 (1)		
Polynuclear Aromatic Hydrocarbons	10-53-7	SV							0.0028**	0.0311**
Pyrene	129-00-0	SV								
Vinyl Chloride	75-01-4	V	2 (a)		0 (a)				2 **	525 **
1,1,1-Trichloroethane	71-55-6	V	200 (a)		200 (a)				18,400	1,030,000
1,1,2,2-Tetrachloroethane	79-34-5	V						2,400	0.17**	10.7 **
1,1,2-Trichloroethane	79-00-5	V	5 (h)		3 (h)			9,400	0.6**	41.8 **
1,1-Dichloroethane	75-34-3	V								
1,1-Dichloroethene	75-35-4	V	7 (a)		7 (a)					
1,2-Dichloroethane	107-06-2	V	5 (a)		0 (a)		118,000	20,000	0.94**	243 **
1,2-Dichloroethene (cis)	156-59-2	V		70 (b)		70 (b)				
1,2-Dichloroethene (total)	540-59-0	V								
1,2-Dichloroethene (trans)	156-60-2	V		100 (b)		100 (b)				
1,2-Dichloropropane	78-87-5	V		5 (b)		0 (b)	23,000	5,700		
1,3-Dichloropropene (cis)	10061-01-5	V					6,060	244 (1)	87	14,100
1,3-Dichloropropene (trans)	10061-02-6	V					6,060	244 (1)	87	14,100
2-Butanone	78-93-3	V								
2-Hexanone	591-78-6	V								
4-Methyl-2-pentanone	108-10-1	V								
Acetone	67-64-1	V								
Acrylonitrile	107-13-1	V					7,550	2,600	0.058	0.65
Benzene	71-43-2	V	5 (a)		0 (a)		5,300		0.66**	40 **
Bromodichloromethane	74-97-2	V	<100 (2)(a)							
Bromoform	75-25-2	V	<100 (2)(a)							
Bromomethane	74-83-9	V								
Carbon Disulfide	75-15-0	V								
Carbon Tetrachloride	56-23-5	V	5 (a)		0 (a)		35,200 (1)		0.4**	6.94 **
Chlorinated Benzenes		V/SV					250 (1)	50 (1)		
Chlorobenzene	108-90-7	V		100 (b)		100 (b)			488	
Chloroethane	75-00-3	V								
Chloroform	67-66-3	V	<100 (2)(a)				28,900 (1)	1,240 (1)	0.19 **	15.7 **

022/724620/87.WK1

TABLE C-2 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

							CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only
Chloromethane	74-87-1	V								
Dibromochloromethane	124-48-1	V	<100 (2)(a)							
Dichloroethenes		V					11,600 (1)		0.033**	1.85 **
Ethylbenzene	100-41-4	V		700 (b)		700 (b)	32,000 (1)		1,400	3,280
Ethylene Dibromide	106-93-4	V		0.05 (b)		0 (b)				
Ethylene Oxide	75-21-8	V								
Halomethanes		V	100 (a)				11,000 (1)		0.19**	15.7 **
Methylene Chloride	75-09-2	V	5 (h)		0 (h)					
Styrene	100-42-5	V		100 (b)		100 (b)				
Tetrachloroethanes		V					9,320 (1)			
Tetrachloroethene	127-18-4	V		5 (b)		0 (b)	5,280 (1)	840 (1)	0.80**	8.85 **
Toluene	108-88-3	V		1,000 (b)		1,000 (b)	17,500 (1)		14,300	424,000
Trichloroethanes		V					18,000 (1)			
Trichloroethene	79-01-6	V	5 (a)		0 (a)		45,000 (1)	21,900 (1)	2.7 **	80.7 **
Vinyl Acetate	108-05-4	V								
Xylenes (total)	1330-20-7	V		10,000 (b)		10,000 (b)				

EXPLANATION OF TABLE AND END NOTES

* = secondary maximum contaminant level, TBCs

** = Human health criteria for carcinogens reported for three risk levels. Value presented is the 10-5 risk level.

*** = Concentration is pH dependent

AWQC = Ambient Water Quality Criteria
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
CWA = Clean Water Act
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
SDWA = Safe Drinking Water Act
SS = Species Specific
SW = Solid Waste
TIC = Tentatively Identified Compound
ug/l = micrograms per liter
MF/L = million fibers/liter

022/724629/87.WK1

TABLE C–2 POTENTIAL CHEMICAL–SPECIFIC BENCHMARKS (JANUARY 25, 1994)
FEDERAL SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (7)	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level	SDWA Maximum Contaminant Level Goals	SDWA Maximum Contaminant Level Goals	CWA AWQC for Protection of Aquatic Life (c)		CWA AWQC for Protection of Human Health (c)	
							Acute Value	Chronic Value	Water and Fish Ingestion	Fish Consumption Only

(1) Criteria not developed; value presented is lowest observed effects level (LOEL)
(2) Total trihalomethanes: chloroform, bromoform, bromodichloromethane, dibromochloromethane
(3) Hardness dependent criteria, calculated assuming 50mg/l calcium carbonate
(4) Average annual concentration of beta particles and photon radioactivity cannot exceed 4 millirem/year dose equivalent.
(5) Standard is not adequately protective when chloride is associated with potassium, calcium, or magnesium, rather than sodium.
(6) If both strontium–90 and tritium are present, the sum of their annual dose equivalents to bone marrow shall not exceed 4 mrem/yr.
(7) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; H=herbicide; IN=inorganic; FP=field parameter; M=metal; P=pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi–volatile; V=volatile
(8) Value for gross alpha excludes uranium

(a) EPA National Primary and Secondary Drinking Water Regulations, as of May 1990, 40 CFR 141 and 40 CFR 143.
(b) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142 and 143, Final Rule, effective July 30, 1992 (56 Federal Register 3526; 1/30/1991).
(c) EPA, Quality Criteria for Protection of Aquatic Life, 1986
(d) EPA, National Ambient Water Quality Criteria for Selenium – 1987
(e) EPA National Primary and Secondary Drinking Water Regulations, 40 CFR Parts 141, 142, and 143, Final Rule (56 FR 30266; 7/1/1991) effective 1/1/1993.
(f) EPA Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper, 40 CFR 141 and 142 (56 FR 26460; 6/7/1991) effective 12/7/92. MCLGs effective 11/6/91. Action level in 10% or less of tap samples for small and medium–sized systems.
(g) EPA, National Ambient Water Quality Criteria for Chloride – 1988
(h) EPA National Primary Drinking Water Regulations, 40 CFR 141 and 142, Final Rule, Effective January 17, 1994
(i) EPA National Primary Drinking Water Regulations, 40 CFR 141, Postponement of Final Rule and Reconsideration (57 FR 22178) – no effective date established.

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994) STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (5)	Statewide Standards (a): Human Health Carcinogens/Noncarcinogens (2)(8): Water Supply	Statewide: Human Health (2)(8): Water and fish	Statewide: Aquatic Life (8): Acute Value	Statewide: Aquatic Life (8): Chronic Value	Statewide: Tables I,II,III (1): Aquatic Life (8,10): Acute Value (2)	Tables I,II,III (1): Aquatic Life (8,10): Chronic Value (2)	Tables I,II,III (1): Agricultural Standard (3,11)	Tables I,II,III (1): Domestic Water Supply (4,11)	Statewide: Organics (6,7) Table 1A	South Platte River Basin Stream Standards (b): Physical, Biological Inorganic, and Metals: Acute(7) Value	South Platte: Physical, Biological Inorganic, and Metals: Chronic(7) Value	South Platte: Radionuclides Table 2: Woman Creek	South Platte: Radionuclides Table 2: Walnut Creek
Chloride	7647-14-5	A								250,000		250,000	250,000		
Cyanide (Free)	74-90-8	A					5	5	200	200		5	5		
Fluoride	10-72-0	A								2,000					
N as Nitrate		A							100,000	10,000		10,000	10,000		
N as Nitrate+Nitrite	10-28-6	A							100,000	10,000					
N as Nitrite	7632-00-0	A					SS	SS	10,000	1,000		500	1,000		
Sulfate	7778-80-5	A								250,000		250,000	250,000		
Sulfide, H2S Undissociated	7783-06-4	A						2		50		2	2		
Coliform (Fecal)	10-06-0	B								2000/100 ml		2,000/100m	2,000/100m		
Ammonia (as N)	7764-41-7	C					TVS	60		500(ammonia as tot)		TVS	100		
Dioxin	1746-01-6	D	2.2E-07	1.3E-08	0.01	1.0E-05					1.30E-08		1.3E-06		
Boron		E							750			750	750		
Chlorine, Total Residual	7782-50-5	E					19	11				19	11		
Sulfur		E											2		
Dissolved Oxygen	10-88-8	FP					>5,000	>5,000	>3,000	>3,000		5,000	5,000		
pH (Standard Units)	10-29-7	FP					6.5-9.0	6.5-9.0		5.0-9.0		6.5-9	6.5-9		
Specific Conductance	10-34-4	FP													
Temperature (Degrees Celsius)		FP					30 degrees	30 degrees							
Alkalinity		IN													
Asbestos (fibers/L)		IN								30,000					
Total Dissolved Solids	10-33-3	IN													
Total Organic Carbon		IN													
Aluminum	7429-90-5	M					750	87							
Antimony	7440-36-0	M								14					
Arsenic	7440-38-2	M					360	150	100	50		50			
Arsenic III		M													
Arsenic V		M													
Barium	7440-39-3	M								1,000					
Beryllium	7440-41-7	M							100	0.0076			4		
Cadmium	7440-43-9	M					TVS	TVS	10	10		TVS	TVS		
Calcium	7440-70-2	M													
Cesium	7440-46-2	M													
Chromium	7440-47-3	M													
Chromium III		M					TVS	TVS	100	50		50			
Chromium VI	7440-47-3	M					16	11	100	50		TVS16	TVS11		

02272462/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994) STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek
Cobalt	7440-48-4	M													
Copper	7440-50-8	M					TVS	TVS	200	1,000		(23)TVS	(23)TVS		
Iron (DIS)	7439-89-6	M								300			300 (3)		
Iron (TR)	7439-89-6	M						1,000					(13,200) 1000		
Lead	7439-92-1	M					TVS	TVS	100	50		(28)TVS	(28)TVS		
Lithium	7439-93-2	M													
Magnesium	7439-95-4	M													
Manganese (DIS)	7439-96-5	M						1,000		50			(560) 50 (3)		
Manganese (TR)	7439-96-5	M							200				1000		
Mercury	7439-97-6	M					2.4	0.1		2			0.01		
Molybdenum	7439-98-7	M													
Nickel	7440-02-0	M					TVS	TVS	200			TVS	TVS		
Potassium	7440-09-7	M													
Selenium	7782-49-2	M					135	17	20	10			10		
Silver	7440-22-4	M					TVS	TVS		50		TVS	TVS		
Sodium	7440-23-5	M													
Strontium	7440-24-6	M													
Thallium	7440-28-0	M						15		0.012					
Tin	7440-31-5	M													
Titanium	7440-32-6	M													
Tungsten	7440-33-7	M													
Vanadium	7440-62-2	M													
Zinc	7440-66-6	M					TVS	TVS	2,000	5,000		(350) TVS	(350) TVS		
Aldicarb	116-06-3	P	10												
Aldicarb Sulfone		P													
Aldicarb Sulfoxide		P													
Aldrin	309-00-2	P	0.002	1.30E-04	1.5						1.3E-04		7.4E-05		
Carbofuran	1563-66-2	P	36												
Chloranil	118-75-2	P													
Chlordane	57-74-9	P	0.03 (8)	5.80E-04	1.2	0.0043					5.8E-04		4.6E-04		
Chlorpyrifos	2921-88-2	P			0.083	0.041									
DDT	50-29-3	P	0.1	5.90E-04	0.55	0.001					5.9E-04		2.4E-05		
DDT Metabolite (DDD)	72-54-8	P		8.30E-04	0.6										
DDT Metabolite (DDE)	72-55-9	P	0.1	5.90E-04	1,050										
Demeton	8065-48-3	P				0.1					0.1				
Diazinon	333-41-5	P													
Dieldrin	60-57-1	P	0.002	1.40E-04	1.3	0.0019					1.4E-04		7.1E-05		
Endosulfan I	959-98-8	P		0.93	0.11	0.056					0.056				
Endosulfan II	33213-65-9	P													

022724628/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994) STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (5)	Statewide Standards (a): Human Health Carcinogens/ Noncarcinogens (2) (8): Water Supply	Human Health: Water and fish	Aquatic Life (8): Acute Value	Aquatic Life (8): Chronic Value	Tables I,II,III (1): Aquatic Life (8,10): Acute Value (2)	Aquatic Life (8,10): Chronic Value (2)	Tables I,II,III (1): Agricultural Standard (3,11)	Tables I,II,III (1): Domestic Water Supply (4,11)	South Platte River Basin Stream Standards (b): Organics (6,7) Table 1A	Physical, Biological Inorganic, and Metals: Acute(7) Value	Physical, Biological Inorganic, and Metals: Chronic(7) Value	Radionuclides Table 2: Woman Creek	Radionuclides Table 2: Walnut Creek
Endosulfan Sulfate	1031-07-8	P		0.93											
Endrin	72-20-8	P	0.2		0.09	0.0023					0.0023				
Endrin Aldehyde	7421-93-4	P	0.2	0.2											
Endrin Ketone	53494-70-5	P													
Guthion (Azinphos methyl)	86-50-0	P				0.01					0.01				
Heptachlor	76-44-8	P	0.008	2.1E-04	0.26	0.0038					2.1E-04		2.8E-04		
Heptachlor Epoxide	1024-57-3	P	0.09	1.0E-04	0.26	0.0038									
Hexachlorocyclohexane, Alpha	319-84-6	P	0.006		0.0039						0.0039		0.0092		
Hexachlorocyclohexane, Beta	319-85-7	P		0.014							0.014		0.0163		
Hexachlorocyclohexane (HCH OR BHC)		P			100										
Hexachlorocyclohexane, Delta	319-86-8	P													
Hexachlorocyclohexane, Technical (Total)	608-73-1	P		0.012							0.012		0.0123		
Hexachlorocyclohexane, Gamma (Lindane)	58-89-9	P	0.2	0.019	1	0.08					0.019		0.0186		
Malathion	121-75-5	P				0.1					0.1				
Methoxychlor	72-43-5	P	40			0.03					0.03				
Mirex	2385-85-5	P				0.001					0.001				
Oxamyl (Vydate)	23135-22-0	P													
Parathion	298-00-0	P									0.4				
Toxaphene	8001-35-2	P	0.03	7.3E-04	0.73	2.0E-04					2.0E-04				
Vaponite 2		P													
Aroclor 1016	12674-11-2	PP													
Aroclor 1221	11104-28-2	PP													
Aroclor 1232	11141-16-5	PP													
Aroclor 1242	53469-21-9	PP													
Aroclor 1248	12674-29-6	PP													
Aroclor 1254	11097-69-1	PP													
Aroclor 1260	11096-82-5	PP													
PCBs (Total)	1336-36-3	PP	0.005	4.4E-05	2	0.014					4.4E-05		7.9E-05		
2,4,5-TP Silvex	93-72-1	H	50												
2,4-D	94-75-7	H	70								70				
Acrolein	107-02-8	H		320	68	21									
Atrazine	1912-24-9	H									3		3		
Bromacil	314-40-9	H													
Dalapon	75-99-0	H													
Dinoseb	88-85-7	H													

02272-4020/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek
Diquat		H													
Endothall	145-73-3	H													
Glyphosate	1071-83-6	H													
Picloram	1918-02-1	H													
Simazine	122-34-9	H									4		4		
Americium (Total)(pCi/l)	7440-35-9	R												0.05	0.05
Americium 241 (pCi/l)	14596-10-2	R													
Cesium 134 (pCi/l)	13967-70-9	R	80(10)											80(a)	80(a)
Cesium 137 (pCi/l)	10045-97-3	R													
Gross Alpha (pCi/l)	10-79-7	R												7	11
Gross Beta (pCi/l)	10-81-1	R												5	19
Plutonium (Total)(pCi/l)	7440-07-5	R												0.05	0.05
Plutonium 238+239+240 (pCi/l)		R	15(10)											15(a)	15(a)
Radium 226+228 (pCi/l)		R	5(10)											5(a)	5(a)
Strontium 89+90 (pCi/l)	11-10-9	R													
Strontium 90 (pCi/l)		R	8(10)											8	8
Thorium 230+232 (pCi/l)		R	60(10)											60(a)	60(a)
Tritium (pCi/l)	10028-17-8	R	20,000(10)											500	500
Uranium 233+234 (pCi/l)	11-08-5	R													
Uranium 235 (pCi/l)	15117-96-1	R													
Uranium 238 (pCi/l)	7440-61-1	R													
Uranium (Total) (pCi/l)	7440-61-1	R					TVS	TVS						5	10
1,2,4,5-Tetrachlorobenzene	95-94-1	SV	2(8)												
1,2,4-Trichlorobenzene	120-82-1	SV													
1,2-Dichlorobenzene (Ortho)	45-50-1	SV	620	620											
1,2-Diphenylhydrazine	122-66-7	SV	0.05	0.04	270										
1,3-Dichlorobenzene (Meta)	541-73-1	SV	620	400											
1,4-Dichlorobenzene (Para)	106-46-7	SV	75	75											
2,4,5-Trichlorophenol	95-95-4	SV													
2,4,6-Trichlorophenol	88-06-2	SV	2	2		970					2		1.2		
2,4-Dichlorophenol	120-83-2	SV	21	21	2,020	365									
2,4-Dimethylphenol	105-67-9	SV			2,120										
2,4-Dinitrophenol	51-28-2	SV	14	14											
2,4-Dinitrotoluene	121-14-2	SV		0.11											
2,6-Dinitrotoluene	606-20-2	SV			330	230									
2-Chloronaphthalene	91-58-7	SV													
2-Chlorophenol	95-57-8	SV			4,380	2,000									
2-Methylnaphthalene	91-57-6	SV													

022724629/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek
2-Methylphenol	95-48-7	SV													
2-Nitroaniline	88-74-4	SV													
2-Nitrophenol	88-75-5	SV													
3-Nitroaniline	99-09-2	SV													
4,6-Dinitro-2-methylphenol	534-52-1	SV		13											
4-Bromophenyl-phenyl-ether	101-55-3	SV													
4-Chloroaniline	106-47-8	SV													
4-Chlorophenyl-phenyl-ether	7005-72-3	SV													
4-Chloro-3-methylphenol	59-50-7	SV			30										
4-Methylphenol	106-44-5	SV													
4-Nitroaniline	100-01-6	SV													
4-Nitrophenol	100-02-7	SV													
Acenaphthene	88-32-9	SV			1,700	520									
Anthracene	120-12-7	SV		0.0028							0.0028				
Benzidine	92-87-5	SV	2.00E-04	1.2E-04(8)	2,500						1.2E-04		1.2E-04		
Benzoic Acid	65-85-0	SV													
Benzo(a)anthracene	56-55-3	SV		0.0028							0.0028				
Benzo(a)pyrene	50-32-8	SV		0.0028							0.0028				
Benzo(b)fluoranthene	205-99-2	SV		0.0028							0.0028				
Benzo(g,h,i)perylene	191-24-2	SV		0.0028							0.0028				
Benzo(k)fluoranthene	207-08-9	SV		0.0028							0.0028				
Benzyl Alcohol	100-51-6	SV													
bis(2-Chloroethoxy)methane	111-91-1	SV													
bis(2-Chloroethyl)ether	111-44-4	SV	0.03 (8)	0.03 (8)							0.03		3.7E-06		
bis(2-Chloromethyl)ether											3.7E-06				
bis(2-Chloroisopropyl)ether	108-60-1	SV		1,400											
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	117-81-7	SV		1.8 (8)											
Butadiene	106-99-0	SV													
Butylbenzylphthalate	85-68-7	SV		3,000											
Chlorinated Ethers		SV													
Chlorinated Naphthalenes		SV													
Chloroalkylethers		SV													
Chlorophenol (Total)		SV									2000				
Chrysene	218-01-9	SV		0.0028							0.0028				
Dibenzofuran	132-64-9	SV													
Dichlorobenzidine (Total)	91-94-1	SV		0.039							0.039		0.01		
Dibenzo(a,h)anthracene	53-70-3	SV		0.0028							0.0028				
Dichlorobenzenes		SV													
Diethylphthalate	84-66-2	SV		23,000											

02272462B/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek
Di(2-ethylhexyl)adipate		SV													
Dimethylphthalate	131-11-3	SV		313,000											
Di-n-butylphthalate	84-74-2	SV		2,700											
Di-n-octylphthalate	117-84-0	SV													
Ethylene Glycol	107-21-1	SV													
Fluoranthene	206-44-0	SV		42	3,980						42				
Fluorene	86-73-7	SV		0.0028							0.0028				
Formaldehyde	500-00-0	SV													
Haloethers		SV													
Hexachlorobenzene	118-74-1	SV	6	7.2E-04							7.2E-04		7.2E-04		
Hexachlorobutadiene	87-68-3	SV	1	0.45	90	9.3					0.45		0.45		
Hexachlorocyclopentadiene	77-47-4	SV		240	7	5									
Hexachloroethane	67-72-1	SV		1.9	980	540					1.9		1.9		
Hydrazine	302-01-2	SV													
Indeno(1,2,3-cd)pyrene	193-39-5	SV		0.0028							0.0028				
Isophorone	78-59-1	SV	1,050	8.4	117,000										
Naphthalene	91-20-3	SV		0.0028	2,300	620					0.0028				
Nitrobenzene	98-95-3	SV	3.5	3.5	27,000										
Nitrophenols		SV													
Nitrosamines		SV													
N-Nitrosodibutylamine	924-16-3	SV		0.0064							0.0064		0.0064		
N-Nitrosodiethylamine	55-18-5	SV		8.0E-04							8.0E-04		8.0E-04		
N-Nitrosodimethylamine	62-75-9	SV		6.9E-04							6.9E-04		0.0014		
N-Nitrosopyrrolidine	930-55-2	SV		0.016							0.016		0.016		
N-Nitrosodiphenylamine	86-30-6	SV		4.9							4.9		4.9		
N-Nitroso-di-n-propylamine	621-64-7	SV		0.005											
Pentachlorinated Ethanes		SV													
Pentachlorobenzene	608-93-5	SV	6 (8)												
Pentachlorophenol	87-86-5	SV	200		9	5.7									
Phenanthrene	85-01-8	SV		0.0028							0.0028				
Phenol	108-95-2	SV		21,000	10,200	2,560									
Phthalate Esters		SV													
Polynuclear Aromatic Hydrocarbons	10-53-7	SV		0.0028											
Pyrene	129-00-0	SV		0.0028							0.0028				
Vinyl Chloride	75-1-4	V	2	2											
1,1,1-Trichloroethane	71-55-6	V	200	200											
1,1,2,2-Tetrachloroethane	79-34-5	V		0.17		2,400					0.17		0.17		
1,1,2-Trichloroethane	79-00-5	V	3	0.6	9,400						0.6		0.6		
1,1-Dichloroethane	75-34-3	V													

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TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek
1,1-Dichloroethene	75-35-4	V	7	0.057											
1,2-Dichloroethane	107-06-2	V	0.4	0.4	118,000	20,000									
1,2-Dichloroethene (cis)	156-59-2	V	70												
1,2-Dichloroethene (total)	540-59-0	V													
1,2-Dichloroethene (trans)	156-60-2	V	100												
1,2-Dichloropropane	78-87-5	V	0.56 (8)	0.56	23,000	5,700									
1,3-Dichloropropene (cis)	10061-01-5	V		10	6,060	244									
1,3-Dichloropropene (trans)	10061-02-6	V		10	6,060	244									
2-Butanone	78-93-3	V													
2-Hexanone	591-78-6	V													
4-Methyl-2-pentanone	108-10-1	V													
Acetone	67-64-1	V													
Acrylonitrile	107-13-1	V		0.058	7,500	2,600					0.058		0.058		
Benzene	71-43-2	V	1	1	5,300										
Bromodichloromethane	74-97-2	V	0.3	0.3							0.3				
Bromoform	75-25-2	V	4	4							4				
Bromomethane	74-83-9	V		48											
Carbon Disulfide	75-15-0	V													
Carbon Tetrachloride	56-23-5	V	0.3	0.25	35,200						(18)				
Chlorinated Benzenes		V/SV													
Chlorobenzene	108-90-7	V	100	100											
Chloroethane	75-00-3	V													
Chloroform	67-66-3	V	6	6	28,900	1,240					6		0.19		
Chloromethane	74-87-1	V		5.7											
Dibromochloromethane	124-48-1	V	14	6							6				
Dichloroethenes		V													
Ethylbenzene	100-41-4	V	680	3,100	32,000										
Ethylene Dibromide	106-93-4	V													
Ethylene Oxide	75-21-8	V													
Halomethanes		V											0.19		
Methylene Chloride	75-09-2	V		4.7							4.7				
Styrene	100-42-5	V													
Tetrachloroethanes		V									(76)		0.8		
Tetrachloroethene	127-18-4	V	5	0.8	5,280	840					0.8				
Toluene	108-88-3	V	1,000	1,000	17,500										
Trichloroethanes		V													
Trichloroethene	79-01-6	V	5	2.7	45,000	21,900					(66)				
Vinyl Acetate	108-05-4	V													
Xylenes (Total)	1330-20-7	V													

02272462/58.WK1

TABLE C-3 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
STATEWIDE AND BASIN (CDH/WQCC) SURFACE WATER QUALITY STANDARDS
ALL VALUES ARE REPORTED IN ug/l UNLESS OTHERWISE NOTED

			Statewide Standards (a)								South Platte River Basin Stream Standards (b)				
			Human Health Carcinogens/ Noncarcinogens (2) (8)		Aquatic Life (8)		Tables I,II,III (1)					Physical, Biological Inorganic, and Metals		Radionuclides Table 2	
							Aquatic Life (8,10)								
Parameter	CAS No.	Type (5)	Water Supply	Water and fish	Acute Value	Chronic Value	Acute Value (2)	Chronic Value (2)	Agricultural Standard (3,11)	Domestic Water Supply (4,11)	Organics (6,7) Table 1A	Acute(7) Value	Chronic(7) Value	Woman Creek	Walnut Creek

EXPLANATION OF TABLE AND END NOTES

CDH = Colorado Department of Health
DIS = dissolved
EPA = Environmental Protection Agency
pCi/L = picocuries per liter
PCB = polychlorinated biphenyl
SS = species specific
SW = Solid Waste
TIC = Tentatively Identified Compounds
TR = total recoverable
TVS = Table Value Standard (hardness dependent)
ug/L = micrograms per liter
WQCC = Water Quality Control Commission

(1) Table I = physical and biological parameters; Table II = inorganic parameters; Table III = metal parameters
Values in Tables I, II, and III for recreational uses, cold water biota and domestic water supply are not included.
(2) In the absence of specific, numeric standards for non-naturally occurring organics, the narrative standard is interpreted as zero with enforcement based on practical quantification levels (PQLs) as defined by CDH/WQCC or EPA
(3) All are 30-day standards except for nitrate+nitrite, nitrate and cyanide
(4) Ammonia, sulfide, chloride, sulfate, copper, iron, manganese, antimony, beryllium, selenium, thallium and zinc are 30-day standards, all others are 1-day standards
(5) Type abbreviations are: A=anion; B=bacteria; C=cation; IN=inorganic; FP=field parameter; H=herbicide; M=metal; P= pesticide; PP=pesticide/PCB; R=radionuclide; SV=semi-volatile.
(6) Site specific organic standards to segment 4 and 5 of Big Dry Creek; otherwise organic standards in reference (a), 3.1.11.
(7) Numbers in parentheses are temporary modifications to stream standards effective until 4/1/96; for non-naturally occuring organics, the narative standard "free from toxics" (section 3.1.11(1)(d) shall be interpreted and applied in accordance with the provisions of section 3.12 consistently for surface and ground waters.
(8) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be the compliance level.
(9) These parameters are to be maintained at the lowest practical level; See section 3.1.11 (f) (2) in (a)
(10) Metals for aquatic life use are stated as dissolved unless otherwise specified.
(11) Metals for agricultural and domestic use are stated as total recoverable (TR) unless otherwise specified.

(a) CDH/WQCC, Colorado Water Quality Standards 3.1.0 (5 CCR 1002-8)

02272462/58.WK1

TABLE C-4 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/kg UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (1)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration Solids (PPM)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration Liquids (mg/L)	STATE BENCHMARKS (b) Maximum allowed Concentration Solids (PPM)	STATE BENCHMARKS (b) Maximum allowed Concentration Liquids (mg/L)
Chloride	7647-14-5	A				
Cyanide (Free)	74-90-8	A	4.416	4.416		
Fluoride	10-72-0	A				
N as Nitrate		A				
N as Nitrate+Nitrite	10-28-6	A				
N as Nitrite	7632-00-0	A				
Sulfate	7778-80-5	A				
Sulfide, H2S Undissociated	7783-06-4	A				
Coliform (Fecal)	10-06-0	B				
Ammonia as N	7764-41-7	C				
Dioxin	1746-01-6	D				
Boron		E				
Chlorine, Total Residual	7782-50-5	E				
Sulfur		E				
Dissolved Oxygen	10-88-8	FP				
pH (Standard Units)	10-29-7	FP				
Specific Conductance	10-34-4	FP				
Temperature (Degrees Celsius)		FP				
Alkalinity		IN				
Asbestos		IN				
Total Dissolved Solids	10-33-3	IN				
Total Organic Carbon		IN				
Aluminum	7429-90-5	M				
Antimony	7440-36-0	M	0.06309	0.06309		
Arsenic	7440-38-2	M	0.3155	0.3155		
Arsenic III		M				
Arsenic V		M				
Barium	7440-39-3	M	6.309	6.309		
Beryllium	7440-41-7	M				
Cadmium	7440-43-9	M	0.06309	0.06309		
Calcium	7440-70-2	M				
Cesium	7440-46-2	M				
Chromium	7440-47-3	M	0.3155	0.3155		
Chromium III		M				
Chromium VI	7440-47-3	M				
Cobalt	7440-48-4	M				
Copper	7440-50-8	M				
Iron	7439-89-6	M				
Lead	7439-92-1	M	j	j		
Lithium	7439-93-2	M				
Magnesium	7439-95-4	M				
Manganese	7439-96-5	M				
Mercury	7439-97-6	M	0.01262	0.01262		
Molybdenum	7439-98-7	M				
Nickel	7440-02-0	M	j	j		
Potassium	7440-09-7	M				
Selenium	7782-49-2	M	0.06309	0.06309		
Silver	7440-22-4	M	0.3155	0.3155		
Sodium	7440-23-5	M				
Strontium	7440-24-6	M				
Thallium	7440-28-0	M	0.01893	0.01893		
Tin	7440-31-5	M				
Titanium	7440-32-6	M				
Tungsten	7440-33-7	M				
Vanadium	7440-62-2	M				
Zinc	7440-66-6	M				
Aldicarb	116-06-3	P	1.253	0.06309		
Aldicarb Sulfone		P				
Aldicarb Sulfoxide		P				
Aldrin	309-00-2	P	0.001351	1.262E-05		

022/724829/58.WK1

TABLE C-4 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/kg UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (1)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
			Solids (PPM)	Liquids (mg/L)	Solids (PPM)	Liquids (mg/L)
Carbofuran	1563-66-2	P				
Chloranil	118-75-2	P				
Chlordane	57-74-9	P	19.44	0.01262		
Chlorpyrifos	2921-88-2	P				
DDT	50-29-3	P	3.109	6.309E-04		
DDT Metabolite (DDD)	72-54-8	P	0.05982	6.309E-04		
DDT Metabolite (DDE)	72-55-9	P	0.9902	6.309E-04		
Demeton	8065-48-3	P				
Diazinon	333-41-5	P				
Dieldrin	60-57-1	P	0.001292	1.262E-05		
Endosulfan I	959-98-8	P				
Endosulfan II	33213-65-9	P				
Endosulfan sulfate	1031-07-8	P				
Endrin	72-20-8	P	1.004	0.001262		
Endrin Aldehyde	7421-93-4	P				
Endrin Ketone	53494-70-5	P				
Guthion (Azinphos methyl)	86-50-0	P				
Heptachlor	76-44-8	P	3.345	0.002524		
Heptachlor Epoxide	1024-57-3	P	0.8346	0.001262		
Hexachlorocyclohexane, Alpha	319-84-6	P				
Hexachlorocyclohexane, Beta	319-85-7	P				
Hexachlorocyclohexane (HCH or BHC)		P				
Hexachlorocyclohexane, Delta	319-86-8	P				
Hexachlorocyclohexane, Technical (Total)	608-73-1	P				
Hexachlorocyclohexane, Gamma (Lindane)	58-89-9	P				
Malathion	121-75-5	P				
Methoxychlor	72-43-5	P	26330	0.6309		
Mirex	2385-85-5	P				
Oxamyl (Vydate)	23135-22-0	P				
Parathion	298-00-0	P				
Toxaphene	8001-35-2	P	79.09	0.03155		
Vaponite 2		P				
Aroclor 1016	12674-11-2	PP				
Aroclor 1221	11104-28-2	PP				
Aroclor 1232	11141-16-5	PP				
Aroclor 1242	53469-21-9	PP				
Aroclor 1248	12674-29-6	PP				
Aroclor 1254	11097-69-1	PP				
Aroclor 1260	11096-82-5	PP				
PCBs (Total)	1336-36-3	PP	12.23	0.003155		
2,4,5-TP Silvex	93-72-1	H	9.905	0.06309		
2,4-Dichlorophenoxyacetic Acid(2,4-D)	94-75-7	H	106.9	6.309E-04		
Acrolein	107-02-8	H	1.181	3.15		
Atrazine	1912-24-9	H				
Bromacil	314-40-9	H				
Dalapon	75-99-0	H				
Dinoseb	88-85-7	H				
Diquat		H				
Endothall	145-73-3	H				
Glyphosate	1071-83-6	H				
Picloram	1918-02-1	H				
Simazine	122-34-9	H				
Americium (Total) (pCi/g)	7440-35-9	R				
Americium 241 (pCi/g)	14596-10-2	R				
Cesium 134 (pCi/g)	13967-70-9	R				
Cesium 137 (pCi/g)	10045-97-3	R				
Gross Alpha (pCi/g)	10-79-7	R			5.0 pCi/g	
Gross Beta (pCi/g)	10-81-1	R			50.0 pCi/g	
Plutonium (Total) (pCi/g)	7440-07-5	R				
Plutonium 238+239+240 (pCi/g)		R			0.9 pCi/g	
Radium 226+228 (pCi/g)		R				
Strontium 89+90 (pCi/g)	11-10-9	R				
Strontium 90 (pCi/g)		R				

022/724629/50.WK1

TABLE C-4 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/kg UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (1)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
			Solids (PPM)	Liquids (mg/L)	Solids (PPM)	Liquids (mg/L)
Thorium 230+232 (pCi/g)		R				
Tritium (pCi/g)	10028-17-8	R				
Uranium 233+234 (pCi/g)	11-08-5	R				
Uranium 235 (pCi/g)	15117-96-1	R				
Uranium 238 (pCi/g)	7440-61-1	R				
Uranium (Total)(pCi/g)	7440-61-1	R				
1,2,4,5-Tetrachlorobenzene	95-94-1	SV	56.03	0.06309		
1,2,4-Trichlorobenzene	120-82-1	SV	12,170	4.4165		
1,2-Dichlorobenzene (Ortho)	45-50-1	SV	4,999	3.785		
1,2-Diphenylhydrazine	122-66-7	SV	6.976E-04	2.524E-04		
1,3-Dichlorobenzene (Meta)	541-73-1	SV	47,900	1.893		
1,4-Dichlorobenzene (Para)	106-46-7	SV	265	0.4732		
2,4,5-Trichlorophenol	95-95-4	SV	21010	25.24		
2,4,6-Trichlorophenol	88-06-2	SV	0.3536	0.01262		
2,4-Dichlorophenol	120-83-2	SV	43290	0.6309		
2,4-Dimethylphenol	105-67-9	SV	12.48	0.1262		
2,4-Dinitrophenol	51-28-2	SV	22.96	4.416E-04		
2,4-Dinitrotoluene	121-14-2	SV				
2,6-Dinitrotoluene	606-20-2	SV				
2-Chloronaphthalene	91-58-7	SV				
2-Chlorophenol	95-57-8	SV	44,120	1.262		
2-Methylnaphthalene	91-57-6	SV				
2-Methylphenol	95-48-7	SV				
2-Nitroaniline	88-74-4	SV				
2-Nitrophenol	88-75-5	SV				
3,3'-Dichlorobenzidine	91-94-1	SV	0.05656	0.0005047		
3-Nitroaniline	99-09-2	SV				
4,6-Dinitro-2-methylphenol	534-52-1	SV				
4-Bromophenyl-phenyl-ether	101-55-3	SV				
4-Chloroaniline	106-47-8	SV				
4-Chlorophenyl-phenyl-ether	7005-72-3	SV				
4-Chloro-3-methylphenol	59-50-7	SV				
4-Methylphenol	106-44-5	SV				
4-Nitroaniline	100-01-6	SV				
4-Nitrophenol	100-02-7	SV				
Acenaphthene	88-32-9	SV				
Anthracene	120-12-7	SV	77.01	0.01262		
Benzidine	92-87-5	SV	1.262E-06	1.262E-06		
Benzoic Acid	65-85-0	SV				
Benzo(a)anthracene	56-55-3	SV	0.0969	6.309E-05		
Benzo(a)pyrene	50-32-8	SV	0.038675	1.893E-05		
Benzo(b)fluoranthene	205-99-2	SV	0.0001643	1.262E-04		
Benzo(g,h,i)perylene	191-24-2	SV				
Benzo(k)fluoranthene	207-08-9	SV	779	0.02524		
Benzyl Alcohol	100-51-6	SV				
bis(2-Chloroethoxy)methane	111-91-1	SV				
bis(2-Chloroethyl)ether	111-44-4	SV	1.893E-04	1.893E-04		
bis(Chloromethyl)ether		SV				
bis(2-Chloroisopropyl)ether	108-60-1	SV	2234	6.309		
bis(2-Ethylhexyl)phthalate (Di(2-ethylhexyl)phthalate)	117-81-7	SV	42.1	0.01893		
Butadiene	106-99-0	SV				
Butylbenzylphthalate	85-68-7	SV	63,750	5.678		
Chlorinated Ethers		SV				
Chlorinated Napthalenes		SV				
Chloroalkylethers		SV				
Chrysene	218-01-9	SV	15.16	0.001262		
Dibenzofuran	132-64-9	SV				
Dibenz(a,h)anthracene	53-70-3	SV	0.007318	4.416E-06		
Dichlorobenzenes		SV				
Diethylphthalate	84-66-2	SV	479,500	189		
Di(2-ethylhexyl)adipate		SV				
Dimethylphthalate	131-11-3	SV	9,232,000	2,524		
Di-n-butylphthalate	84-74-2	SV				
Di-n-octylphthalate	117-84-0	SV	34,410	3.785		
Ethylene Glycol	107-21-1	SV				

022/72 4629/59.WK1

TABLE C-4 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/kg UNLESS OTHERWISE NOTED

			FEDERAL BENCHMARKS (a)		STATE BENCHMARKS (b)	
			Maximum allowed Concentration		Maximum allowed Concentration	
Parameter	CAS No.	Type (1)	Solids (PPM)	Liquids (mg/L)	Solids (PPM)	Liquids (mg/L)
Fluoranthene	206-44-0	SV	29,710	1.262		
Fluorene	86-73-7	SV	10.48	0.01262		
Formaldehyde	500-00-0	SV				
Haloethers		SV				
Hexachlorobenzene	118-74-1	SV	0.2619	1.262E-04		
Hexachlorobutadiene	87-68-3	SV	5.139	3.155E-03		
Hexachlorocyclopentadiene	77-47-4	SV	8,283	1.262		
Hexachloroethane	67-72-1	SV	2.956	0.01893		
Hydrazine	302-01-2	SV	6.309E-05	6.309E-05		
Indeno(1,2,3-cd)pyrene	193-39-5	SV	29,700	1.262E-03		
Isophorone	78-59-1	SV	13,450	44.16		
Naphthalene	91-20-3	SV	573,800	63.09		
Nitrobenzene	98-95-3	SV	6.557	0.1262		
Nitrophenols		SV				
Nitrosamines		SV				
N-Nitrosodibutylamine	924-16-3	SV				
N-Nitrosodiethylamine	55-18-5	SV				
N-Nitrosodimethylamine	62-75-9	SV				
N-Nitrosopyrrolidine	930-55-2	SV	1.262E-04	1.262E-04		
N-Nitrosodiphenylamine	86-30-6	SV	6.309E-05	6.309E-05		
N-Nitroso-di-n-dipropylamine	621-64-7	SV				
Pentachlorinated Ethanes		SV				
Pentachlorobenzene	608-93-5	SV	2,284	1.893E-04		
Pentachlorophenol	87-86-5	SV	2,917	1.262		
Phenanthrene	85-01-8	SV	13.98	0.01262		
Phenol	108-95-2	SV	20,510	0.01262		
Phthalate Esters		SV				
Polynuclear Aromatic Hydrocarbons	10-53-7	SV				
Pyrene	129-00-0	SV	407,600	6.309		
Vinyl Chloride	75-01-4	V	0.1822	0.01262		
1,1,1-Trichloroethane	71-55-6	V	222.9	1.262		
1,1,2,2-Tetrachloroethane	79-34-5	V	5.832E-03	1.262E-03		
1,1,2-Trichloroethane	79-00-5	V	0.02315	3.785E-03		
1,1-Dichloroethane	75-34-3	V	0.0114	2.254E-03		
1,1-Dichloroethene	75-35-4	V	1.27	0.04416		
1,2-Dichloroethane	107-06-2	V	0.3717	0.03155		
1,2-Dichloroethene (cis)	156-59-2	V	29.73	0.0000004416		
1,2-Dichloroethene (total)	540-59-0	V				
1,2-Dichloroethene (trans)	156-60-2	V	36.41	0.6309		
1,2-Dichloropropane	78-87-5	V	0.6995	0.03155		
1,3-Dichloropropene (cis)	10061-01-5	V				
1,3-Dichloropropene (trans)	10061-02-6	V				
2-Butanone	78-93-3	V				
2-Hexanone	591-78-6	V				
4-Methyl-2-pentanone	108-10-1	V				
Acetone	67-64-1	V	517	25.24		
Acrylonitrile	107-13-1	V	3.785E-04	3.785E-04		
Benzene	71-43-2	V	0.8879	0.03156		
Bromodichloromethane	74-97-2	V	754.6	4.4165		
Bromoform	75-25-2	V				
Bromomethane	74-83-9	V	36.06	0.3155		
Carbon Disulfide	75-15-0	V	12,770	25.24		
Carbon Tetrachloride	56-23-5	V	1.408	0.03155		
Chlorinated Benzenes		V/SV				
Chlorobenzene	108-90-7	V	152.6	0.6309		
Chloroethane	75-00-3	V				
Chloroform	67-66-3	V	0.4968	0.03785		
Chloromethane	74-87-1	V				
Dibromochloromethane	124-48-1	V				
Dichloroethenes		V				
Ethylbenzene	100-41-4	V	4984	4.416		
Ethylene Dibromide	106-93-4	V	6.078E-04	3.155E-04		
Ethylene Oxide	75-21-8	V	6.309E-04	6.309E-04		
Halomethanes		V				
Methylene Chloride	75-09-2	V				

022/724629/59.WK1

TABLE C-4 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (JANUARY 25, 1994)
SOIL CONTAMINANT CRITERIA
ALL VALUES ARE IN mg/kg UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (1)	FEDERAL BENCHMARKS (a) Maximum allowed Concentration		STATE BENCHMARKS (b) Maximum allowed Concentration	
			Solids (PPM)	Liquids (mg/L)	Solids (PPM)	Liquids (mg/L)
Styrene	100-42-5	V	2.343	0.03155		
Tetrachloroethanes		V				
Tetrachloroethene	127-18-4	V	3.48	0.03155		
Toluene	108-88-3	V	11,730	12.62		
Trichloroethanes		V				
Trichloroethene	79-01-6	V	1.146	0.03155		
Vinyl Acetate	108-05-4	V				
Xylenes (total)	1330-20-7	V				

EXPLANATION OF TABLE AND ENDNOTES

CDH = Colorado Department of Health
EPA = Environmental Protection Agency
pCi/l = picocuries per liter
PCB = polychlorinated biphenyl
RCRA = Resource Conservation Recovery Act
RFP = Rocky Flats Plant
SDWA = Safe Drinking Water Act
TIC = Tentatively Identified Compound
mg/Kg = milligrams per kilogram

(1) Type abbreviations are: A=anion; B=bacteria; C=cation; D=dioxin; E=element; FP=field parameter; H=herbicide; IN=inorganic; M=metal; P=pesticide; PP= pesticide/PCB; R=radionuclide; SV=semi-volatile; V=volatile

(a) EPA Guidance 9347.3-09FS, A Guide to Delisting of RCRA Wastes for Superfund Remedial Responses: Based on Health-based 10-6 risk, developed for delisting hazardous wastes and waste residuals.

(b) Value derived from Colorado Radiation Control Rules and Regulations, 1985 as amended 1990.

TABLE C-5 POTENTIAL CHEMICAL-SPECIFIC BENCHMARKS (January 25, 1994)
AIR QUALITY STANDARDS
ALL VALUES ARE IN ug/m3 UNLESS OTHERWISE NOTED

Parameter	CAS No.	Type (1)	Federal Standards (3)	State Standards (3)
Lead		M	1.5 ug/m3 (a)	1.5 ug/m3 (a)
Beryllium		M		0.01 ug/L
Ozone		I	235 ug/m3 (b)	235 ug/m3 (b)
Americium	7440-35-9	R	(2)(c)	(d)
Americium 241	14596-10-2	R	(2)(c)	(d)
Cesium 134	13967-70-9	R	(2)(c)	(d)
Cesium 137	10045-97-3	R	(2)(c)	(d)
Gross Alpha	10-79-7	R	(2)(c)	(d)
Gross Beta	10-81-1	R	(2)(c)	(d)
Plutonium	7440-07-5	R	(2)(c)	(d)
Plutonium 238+239+240		R	(2)(c)	(d)
Radium 226+228		R	(2)(c)	(d)
Strontium 89+90	11-10-9	R	(2)(c)	(d)
Strontium 90		R	(2)(c)	(d)
Thorium 230+232		R	(2)(c)	(d)
Tritium	10028-17-8	R	(2)(c)	(d)
Uranium 233+234	11-08-5	R	(2)(c)	(d)
Uranium 235	15117-96-1	R	(2)(c)	(d)
Uranium 238	7440-61-1	R	(2)(c)	(d)
Uranium (Total)	7440-61-1	R	(2)(c)	(d)

EXPLANATION OF TABLE AND ENDNOTES

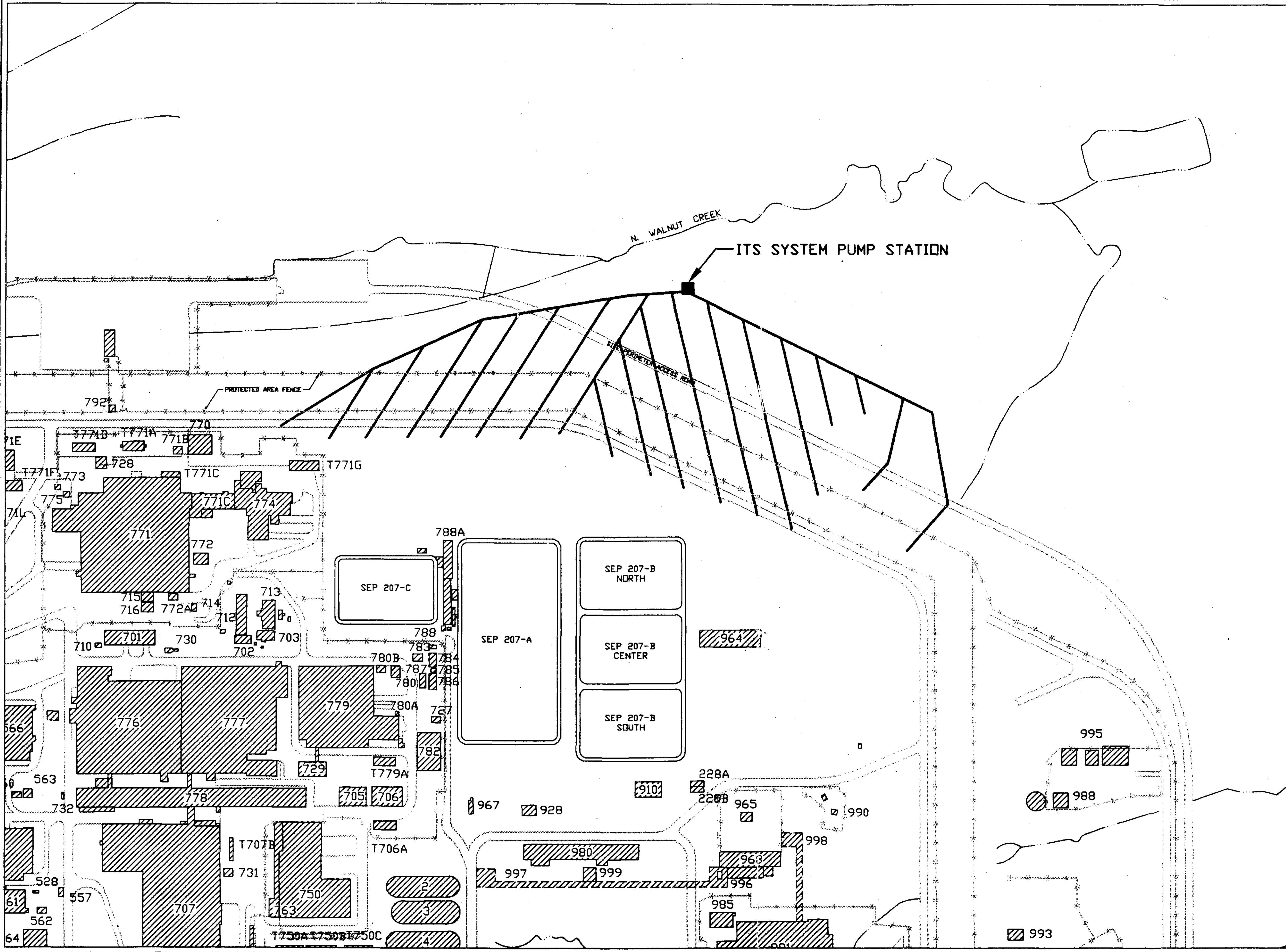
CCR = Code of Colorado Regulations
CDH = Colorado Department of Health
CFR = Code of Federal Regulations
RFP = Rocky Flats Plant
ug/m3 = micrograms per cubic meter

(1) Type abbreviations are: IN=inorganic; M=metal; R=radionuclides
(2) 10 mrem/yr to the general public
(3) Where the standard is below (more stringent than) the PQL, the PQL is interpreted to be compliance level

(a) National Ambient Air Quality Standard (Calender Quarter) primary and secondary
(b) National Ambient Air Quality Standard, (1 hour) primary and secondary
(c) National Emission Standard Hazardous Air Pollutants 40 CFR 61 Subpart H
(d) Requirements of State Implementation Plan (SIP) under Section 110 of the Clean Air Act as as implemented by State SIP of October 5, 1979, as amended and 5 CCR 1001-3.

REFERENCES

EG&G, 1993. *A Managed Approach to Developing Analytical Programs, Site Characterization, and Regulatory Benchmarks - Draft*. EG&G, Rocky Flats Plant, Golden, Colorado.



LEGEND:

- Streams
- Paved Roads
- Buildings
- Fence
- Interceptor Trench Systems

N

100 0 100 200 300 FEET

PREPARED FOR
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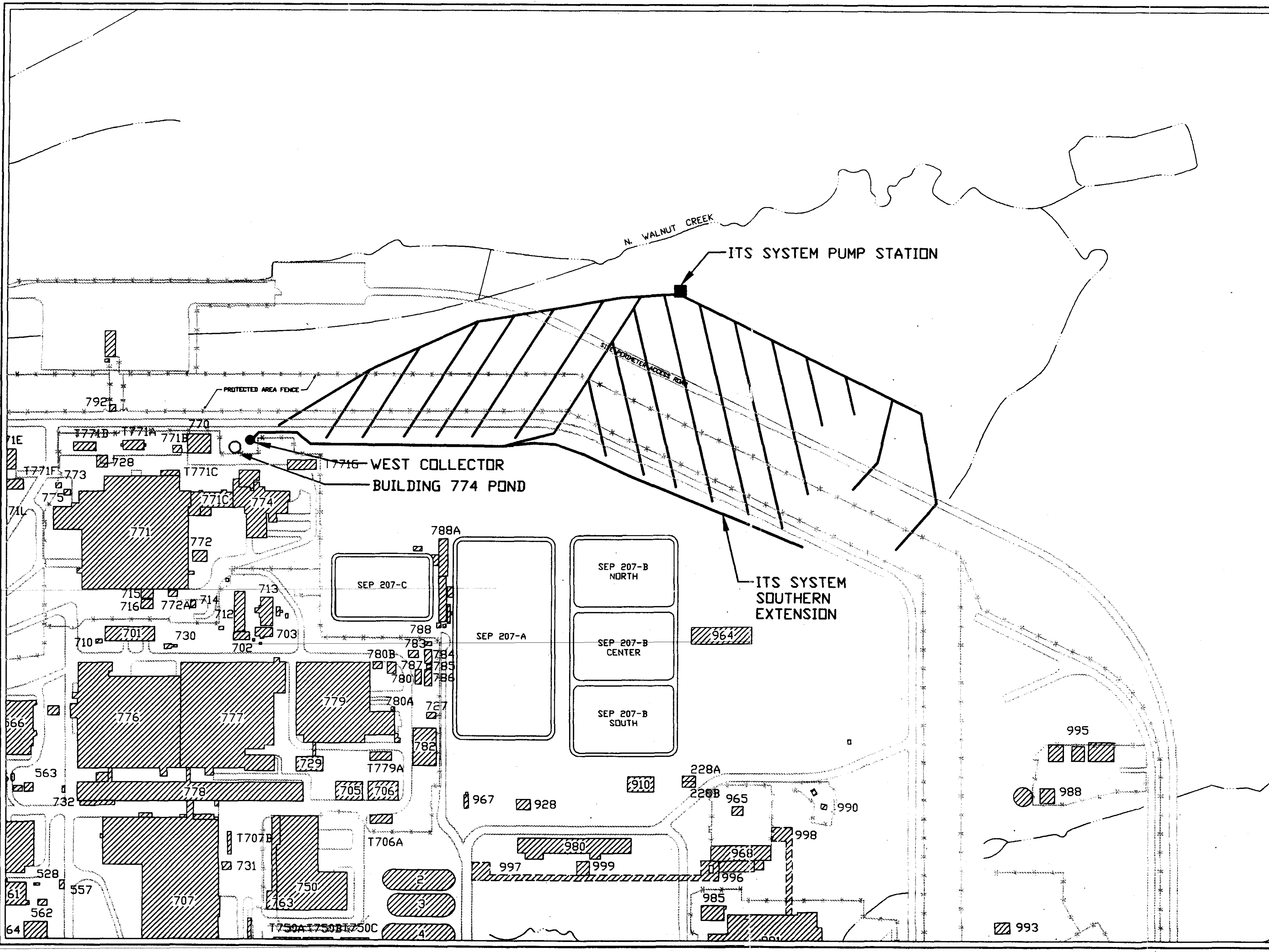
ROCKY FLATS PLANT
GOLDEN, COLORADO

Figure A-1

OU4 Phase II Work Plan
Original ITS System



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ROCKY FLATS PLANT
GOLDEN, COLORADO

Figure A-2

OU4 Phase II Work Plan
Final ITS Configuration With
Southern Extension

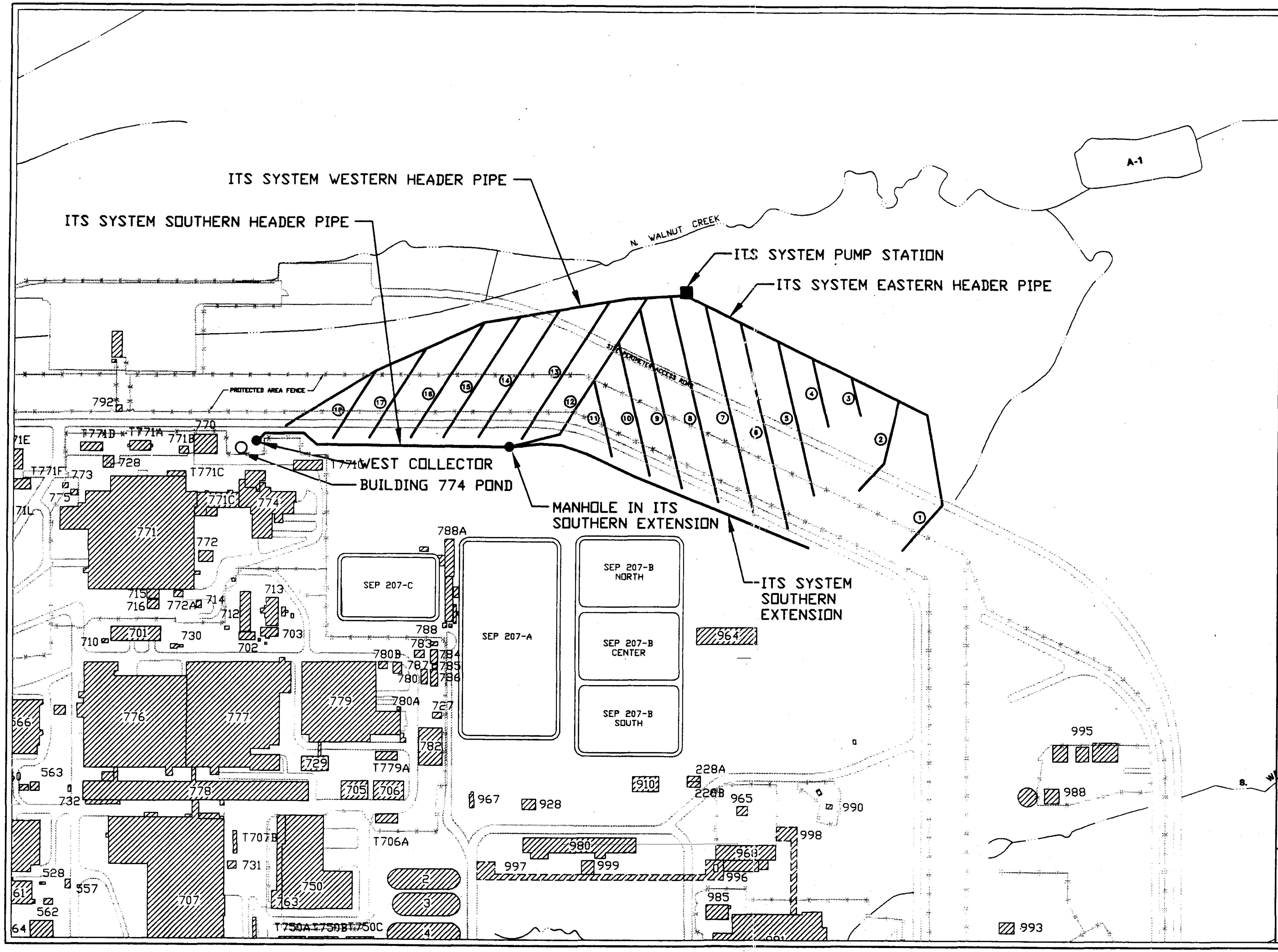

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Figure A-3

OU4 Phase II Work Plan
ITS System Pipe Numbering and General System Layout

NOTICE:

The following two pages were misnumbered when originally printed. Figure A-5 should be numbered A-26. Figure A-6 should be numbered A-27. No pages are missing from this document.

The Administrative Record Staff

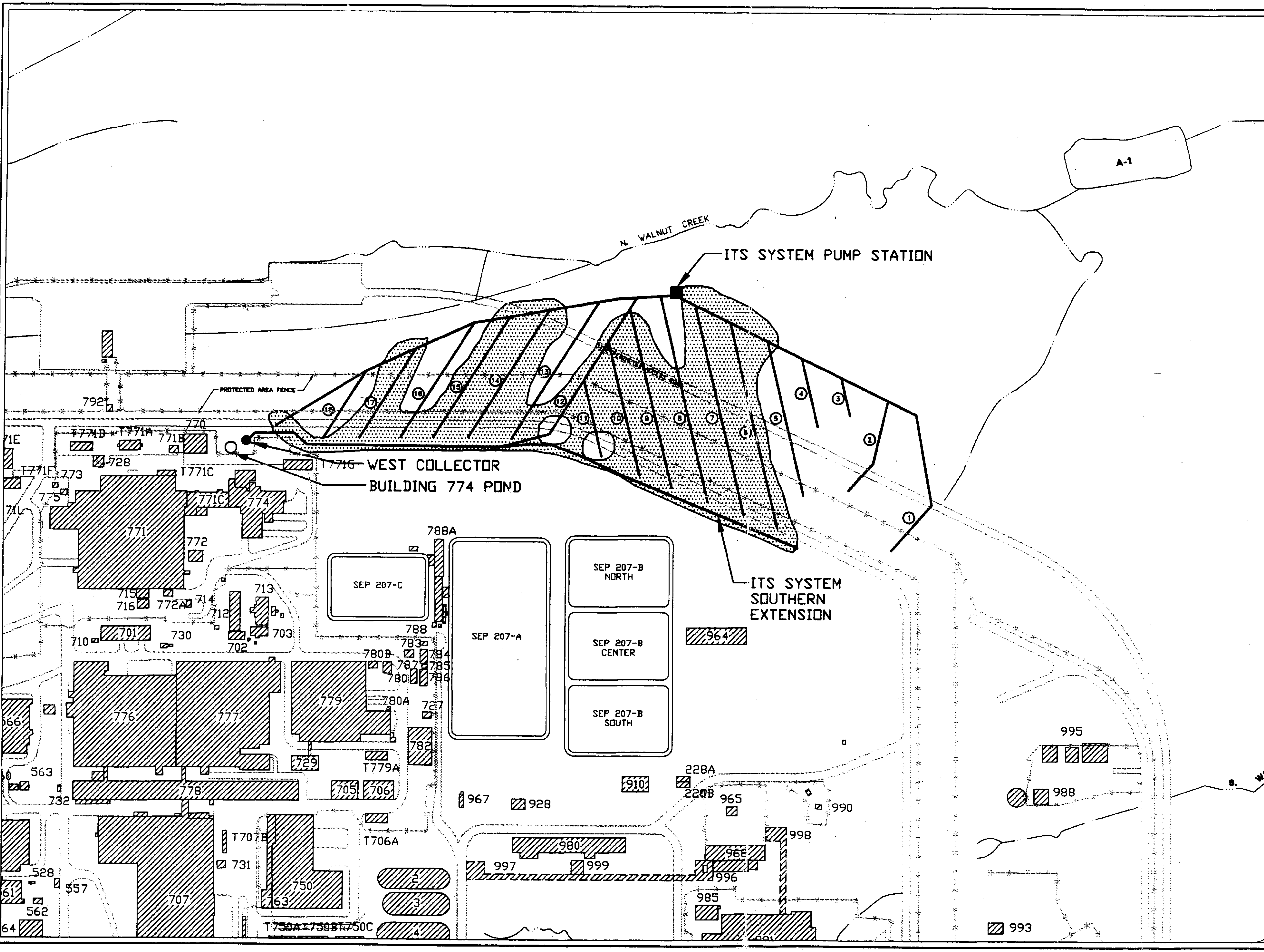

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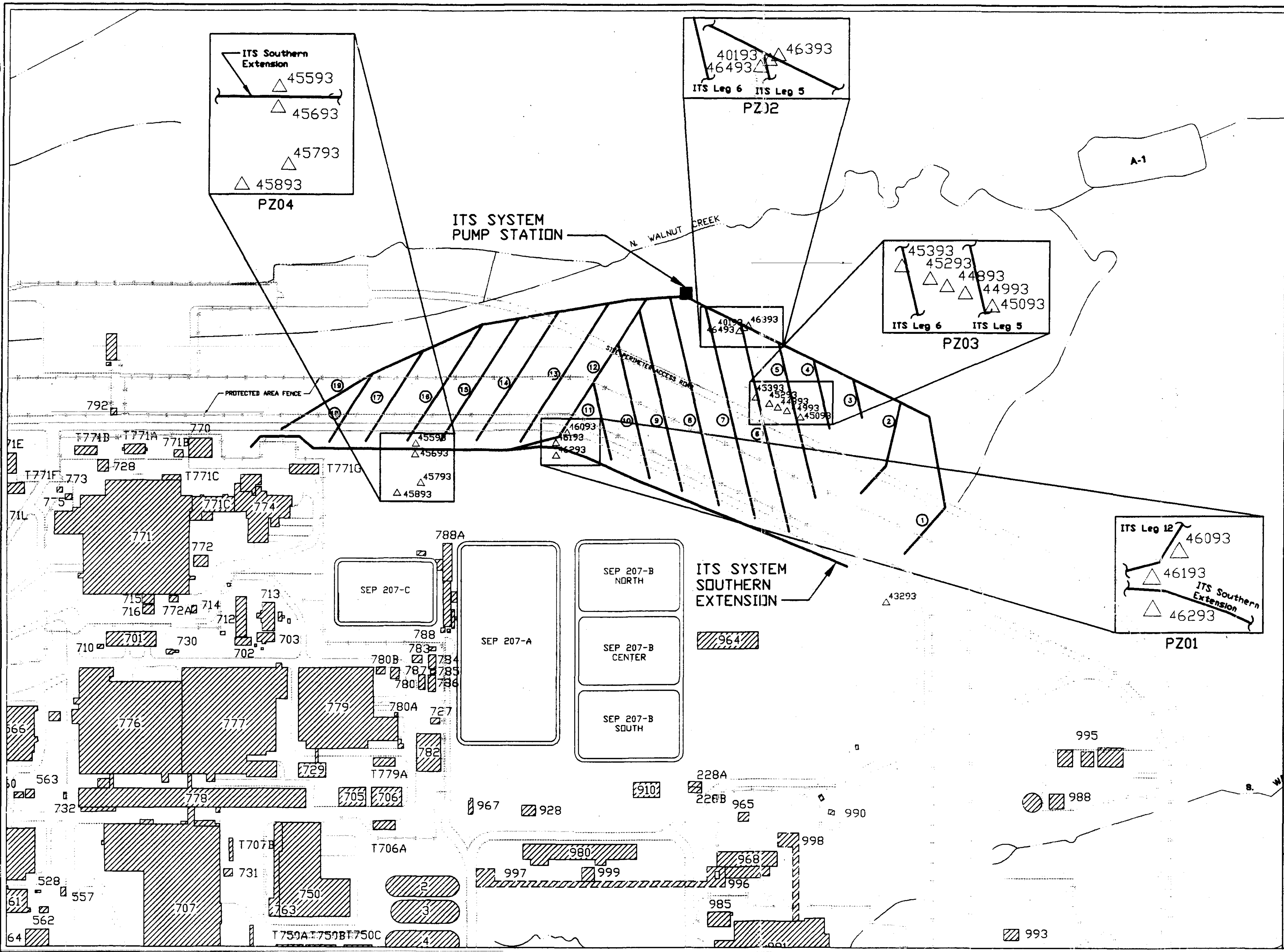
Figure A-5

OU4 Phase II Work Plan
Areas Where ITS is Keyed Into Bedrock



LEGEND:

- Streams
- Paved Roads
- Buildings
- Fence
- Interceptor Trench System
- ITS Pipe Number
- Piezometer Location

100 0 100 200 300 FEET

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Figure A-6

OU4 Phase II Work Plan
ITS and Piezometer Locations